Skyways

Flight Operations • Engineering • Management

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Operation of an
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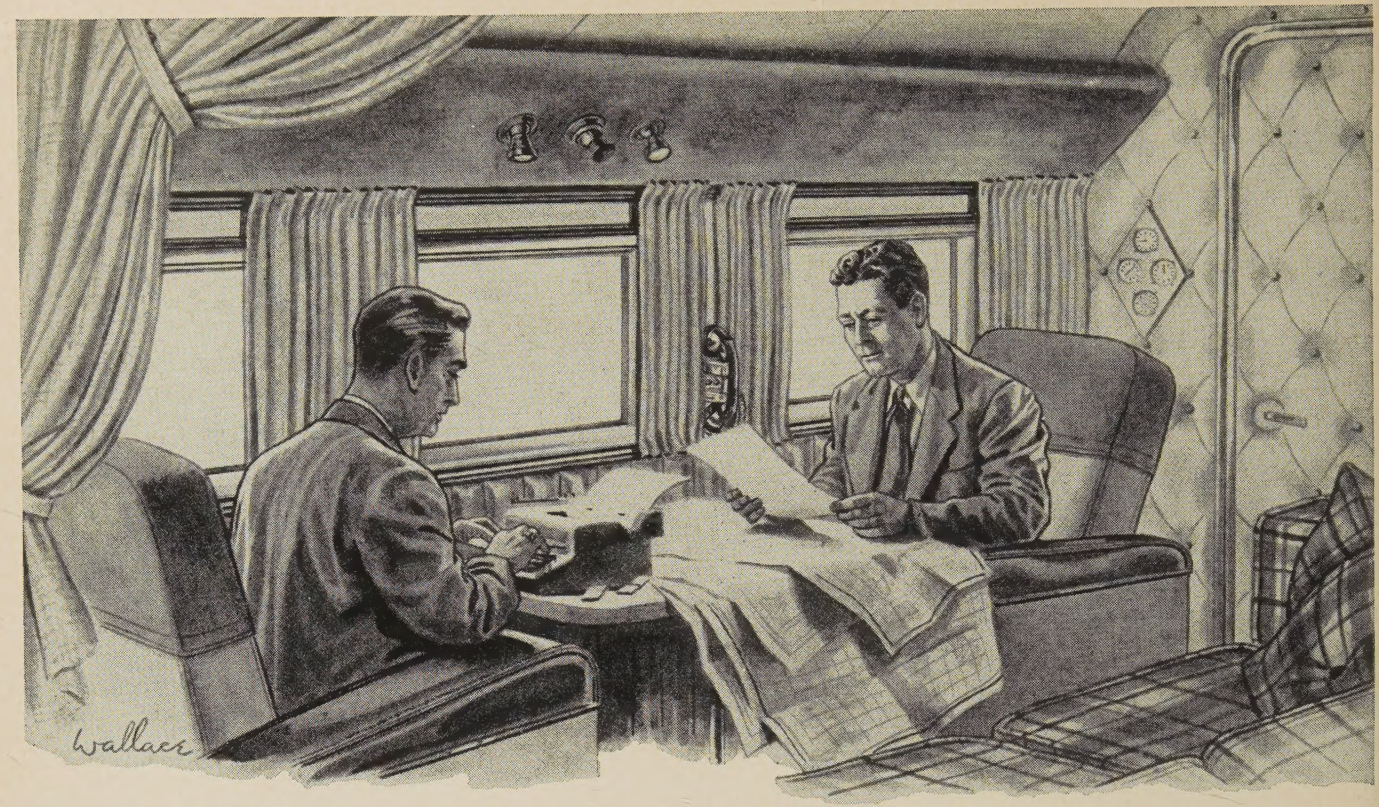
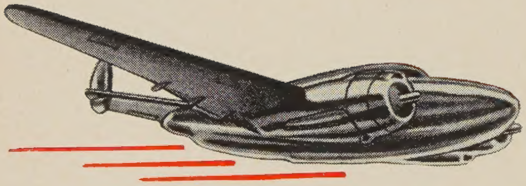


Wings on your office



The pressure of modern business sometimes demands that an executive be in two different places at the same time. Nobody can do that, of course. But hundreds of the nation's most progressive companies have discovered that their key men *can* be in two places — hundreds of miles apart — on the *same day*. The secret of this valuable sleight-of-hand is the modern executive aircraft.

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JULY, 1954

Skyways

Flight Operations • Engineering • Management

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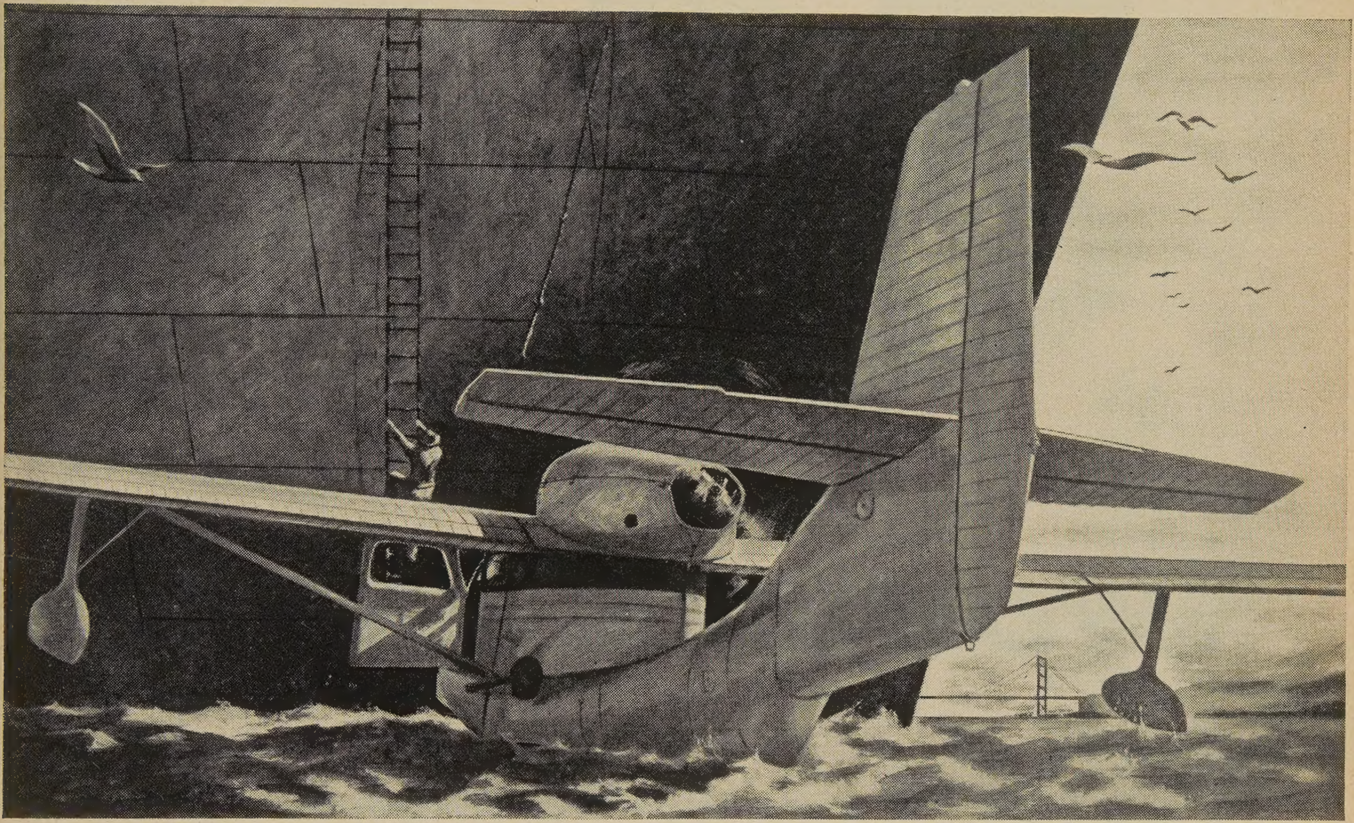

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Quick delivery! When a freighter went aground last February in San Francisco Bay, Bob Law of Commodore Air Service, Sausalito, flew marine engineers to the ship less than an hour later. They were able to get the freighter afloat on a rising tide the same morning.

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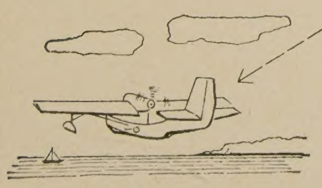

TIP OF THE MONTH

If you're not used to landing on really smooth water, remember that it's impossible to judge altitude over a glassy surface. It's wise to set up a landing attitude on the final approach, and descend slowly with power.

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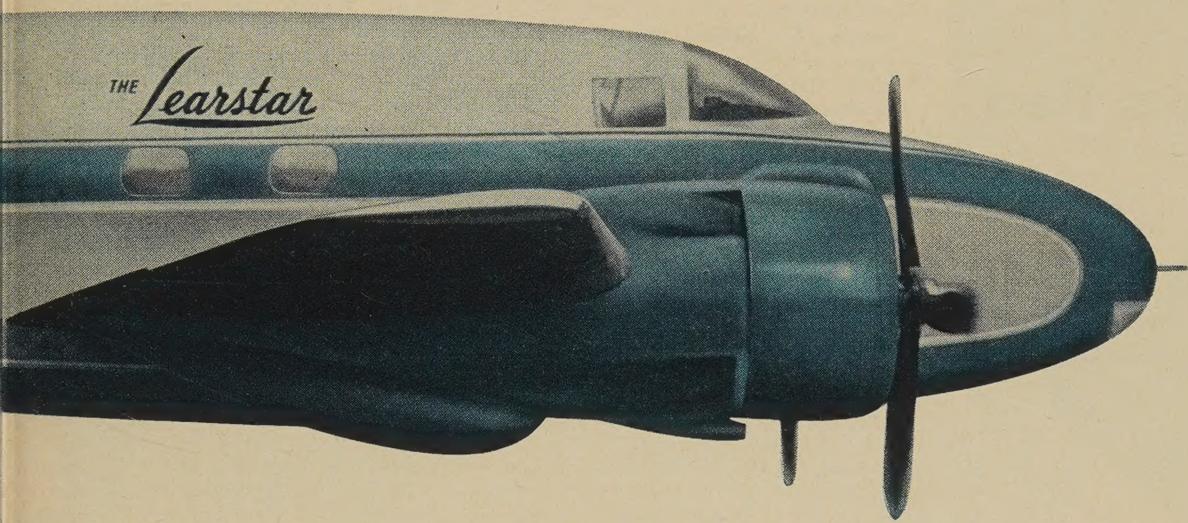
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PERSONNEL

A. M. Rochlen and **K. G. Farrar** have been named vice presidents of Douglas Aircraft Company. Mr. Rochlen is director of public relations, and Mr. Farrar is general manager of the Douglas Long Beach Division.

Frank W. Nelson, former assistant manager of Garrett Supply Company, Los Angeles, has been upped to manager.

Walter G. Bain, vice president and executive assistant to Mundy I. Peale, president of Republic Aviation, has been appointed vice president and general manager.

Edward T. Bolton recently was appointed executive vice president and general manager and member of the Board of Directors of Hiller Helicopters, Palo Alto, Calif.

James K. Pickard, former member of the U. S. Atomic Energy Commission, has opened a consulting practice in atomic energy developments. His office is in Washington, D. C.

Edward I. Brown has joined Vickers, Inc., as Chief Aircraft Products Engineer for Vickers' El Segundo (Calif.) Division.

Norman Caplan is now manager of commercial engineering at the Bendix Radio Communications Division of Bendix Aviation. He replaces **Douglas M. Heller** who has been named director of engineering at the Bendix missile plant at Mishawaka, Ind.

Charles A. Bucks, former District Sales Manager for Pioneer Air Lines in the Dallas territory, is now Regional Sales Manager for Texas and New Mexico.

Merrit Eusey, former head of Minneapolis-Honeywell's Baltimore branch, has been named to head M-H's Pittsburgh office. **Robert S. Warnick** has succeeded Mr. Eusey as branch manager of the Baltimore branch. **Donald H. Hannasch** has been appointed to the newly created position of district manager at Greensboro, N. C.

Bill Grisamore has been transferred from the Cessna Aircraft Wichita plant to the Cessna Prospect plant. He now handles procurement on the T-37A jet training program.

Edward Scofield has been named public relations director of the Aircraft Parts Manufacturers Association of California.

Gen. John K. Cannon recently was elected Chairman of the Board and **Maj. Gen. Leroy H. Watson** was appointed assistant to the president of Fletcher Aviation Corp., Pasadena, Calif.

Robert Conant has been appointed chief inspector at Aeroquip Corp., Jackson, Mich.

John W. Carson is now quality control manager of Continental Aviation & Engineering Corporation's manufacturing and research divisions.

Walter Venghaus has been appointed manufacturing manager of Flight Refueling, Inc., of Baltimore, Md.

Norman L. Winter has been named Director of Federal Dept. of Sperry Gyroscope Company, Great Neck, N. Y.

COMPANIES

Fleet Manufacturing Ltd., Fort Erie, Ontario, Canada, has concluded an arrangement with Helio Aircraft for exclusive manufacturing and sales rights for Canada and the British Commonwealth of Nations for the Helio *Courier* aircraft.

Ryan Aeronautical has received a contract from the Airborne Equipment Div. of the U. S. Navy BuAer for the development of a self-contained airborne helicopter hovering device.

Grand Central Aircraft has received a contract from the USAF for the overhaul of a quantity of Beech C-45G's.

HONORS

Herb Fisher, Chief, Aviation Development Division of Port of New York Authority and SKYWAYS' evaluation pilot, recently was awarded one of Britain's highest pilot honors, a Pilot's Certificate, First-Class, by the Royal Aero Club and the Federation Aeronautique Internationale of the United Kingdom. The award was for Mr. Fisher's 11,000 accident-free flying hours and his record of flight research on commercial and military aircraft over the past 25 years. Presentation of the Certificate was by Lord Brabazon of Tara, President, and R. L. Preston, Secretary-General, of the Royal Aero Club.

Roy T. Hurley, chairman and president of Curtiss-Wright, received the first International Aviation Trade Show award for "his patriotic efforts to create a stronger aircraft industry in support of national defense and air commerce."

Charles H. Kaman, president of Kaman Aircraft Corp., was awarded the Connecticut Junior Chamber of Commerce "Distinguished Service Award" in recognition of "his outstanding contribution to Connecticut in founding and guiding what has become one of Connecticut's leading industrial enterprises."

Edward H. Heinemann, Chief Engineer of Douglas Aircraft Co., was given the "Aviation Man of the Year Award" by the Los Angeles Chamber of Commerce Aviation Committee.

AERO CALENDAR

July 3-6—Eighth Annual All Women Transcontinental Air Race, sponsored by Ninety-Nines, Inc., Long Beach, Calif., to Knoxville, Tenn.

July 4—Western Air Show and Races, sanctioned by NAA. Dansville, N. Y.

July 19-23—Annual USAF model airplane contest. Biggs AFB, El Paso, Texas.

July 27-Aug 5—Twenty-first National Soaring Championship. Elsinore, Calif.

Aug. 9-11—Turbine-power Air Transportation Meeting, Seattle, sponsored by IAS.

Sept. 4-6—Nat'l Aircraft Show, Dayton.

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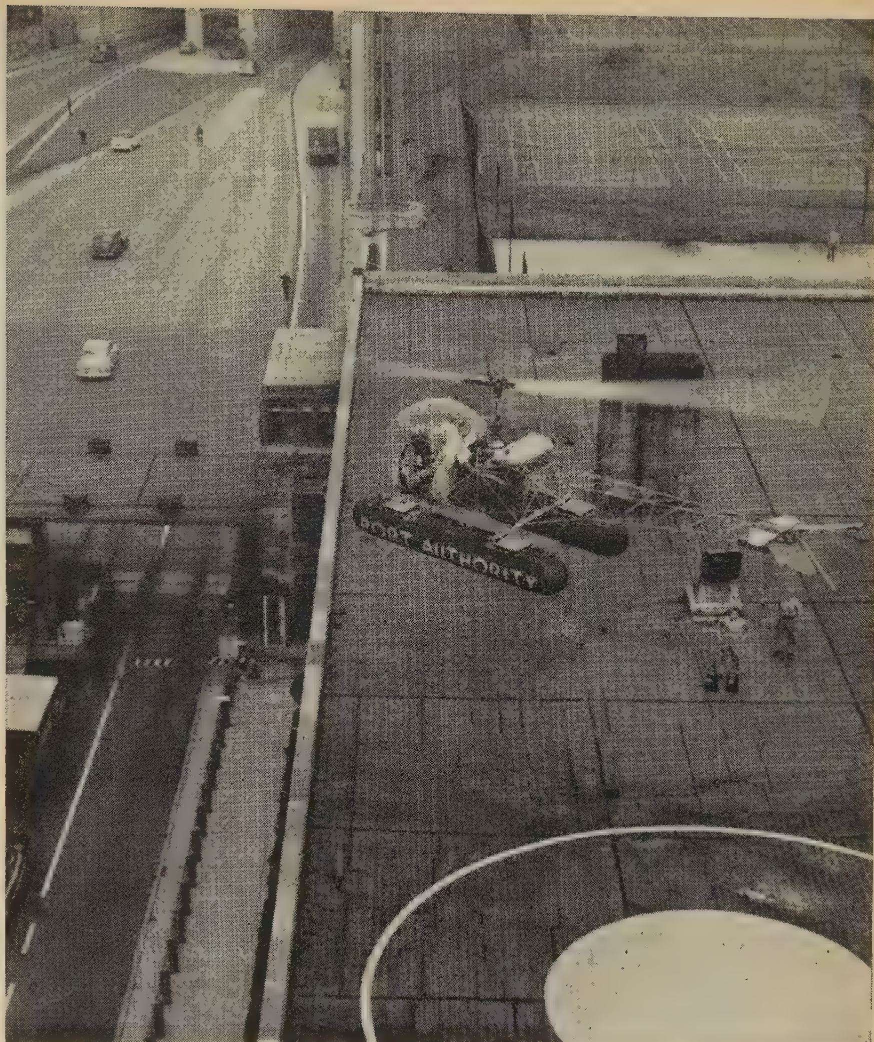
Operation of Executive 'Copters

by Herbert O. Fisher

Chief, Aviation Development
Port of New York Authority



EXECUTIVE *helicopter transport in action: A Port of New York Authority copter leaves Lincoln Tunnel heliport with an inspector for 3-minute flight to the PA roof*

The emphasis on greater speed and range in business-type aircraft has tended to obscure the parallel need for dependable, time-saving short-haul transportation in the expanding field of executive air travel.

The rising tempo of competition in business and industry dictates more frequent travel by top supervisory personnel from factory-to-factory, from office-to-factory and from factory-to-airport. Ground transportation, with its traffic snarls and slow speeds, can't meet their requirements.

With the helicopter, however, they can literally rise above this problem. It can over-fly traffic bottlenecks on the ground and, at the same time, under-fly fixed-wing air traffic. It provides the shortest distance between two points and offers the busy executive door-to-door or roof-to-roof travel and convenience. In short, it opens up a completely new field of air transportation—the short-haul trip now the province of the taxi, the bus and the company car.

The helicopter has been used largely for commercial and military short-haul work since it became a practical piece of equipment, and the large industry contemplating rotary-wing aircraft operations for daily executive shuttle trips within a small geographical area has few case histories to guide it. The Port of New York Authority's three-year experience in the use of helicopters for daily, tightly scheduled executive transportation has, we believe, established a pattern which could be adapted, with some modifications, by business and industry. It is the only door-to-door type of operation described earlier in this article.

As a corporate agency sponsored by New York and New Jersey, the Port Authority's job is to operate transportation and terminal facilities in, and to promote the commerce of, the New Jersey-New York port district—an area within a 25-mile radius of the Statue of Liberty.

By 1950, the Port was operating 15 facilities, including bridges, vehicular tunnels, piers, truck terminals, a grain terminal, a railroad freight terminal, and four airports—LaGuardia, New York International, Newark and Teterboro. And by that year the problem of staff transportation had become a major problem. On the ground, it was almost a one-hour trip from the Port's headquarters in downtown New York to International Airport on Jamaica Bay. And a trip from International Airport to one of the New Jersey airports—a trip engineers and other personnel often had to make—was likely to consume close to two hours.

The extent to which central office-field relationships were handicapped by ground transportation problems is indicated in a letter Austin J. Tobin, executive director of the Port Authority, wrote while the purchase of a helicopter was under consideration. He predicted that the 'copter "probably would be in rather active use by our staff on Saturdays and Sundays, since that is about the only chance that most of us get to inspect the facilities." It is a testimonial to the value of the helicopter as an essential tool in the conduct of Port Authority business that, almost from

the beginning, PA executives have used the helicopter every day in the week as well as on weekends. When a trip becomes necessary on a working day, the executive making it knows that with the helicopter as his transportation he'll only be away from his office a short time.

The Board of Commissioners' recommendation that a helicopter be purchased was based on a staff report which emphasized that "operations and engineering personnel have been greatly handicapped by the time lost in transportation through highly congested surface streets between widely separated air terminals."

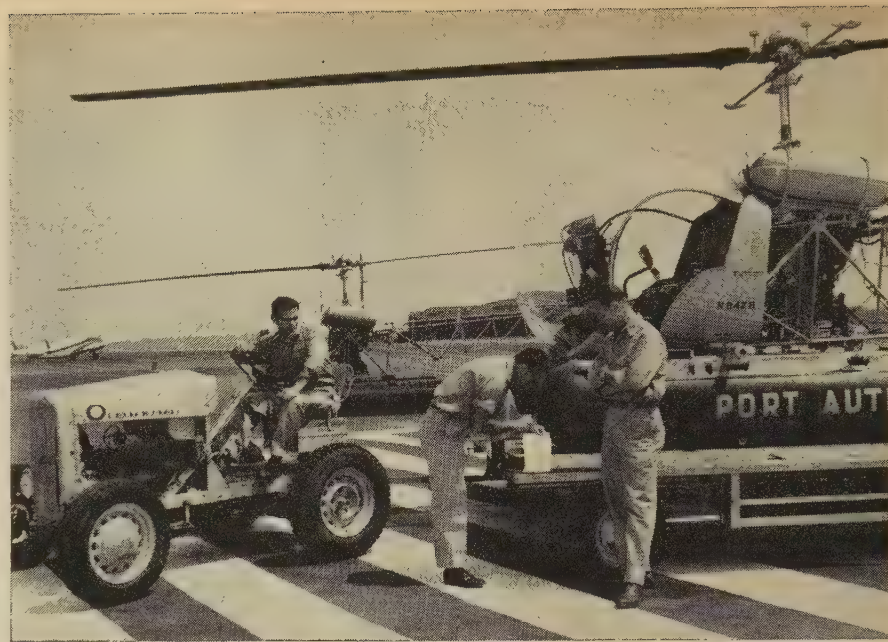
A study preceding the report to the Board revealed that a better inter-facility transportation service was feasible and that its direct benefits would be tremendous savings in staff time and increased efficiency. It pointed out that expediting trips to the field would result in more such trips being made and that, in turn, would result in closer relationships and rapport between field and central office personnel. Such searching studies are vitally essential to any company contemplating establishing executive helicopter service or integrating helicopters into a business aircraft operation.

It was obvious to the Port Authority that the value of the helicopter was completely dependent upon availability of a landing area convenient to the main offices in downtown New York. The most convenient space turned out to be the roof of the Port's 16-story office building.

Amusing in retrospect was the specification that the prospective supplier of our first helicopter "shall make an actual flight off the roof of the Port Authority building to demonstrate that it can be done." That requirement is a good indication of how little we appreciated the capabilities of this strange and wonderful beast called the helicopter less than four years ago.

Today, there is no doubt that it can be done. The Port's helicopters average 20 landings a day on our roof, settling gently down each time on a 40 x 45 ft platform set on steel columns attached to the existing building columns. The platform, raised seven feet above the roof and surrounded by a fence sloping outward at a 30° angle, has a reinforced asphalt surface. The structure weighs only 30 pounds per square foot and is capable of carrying a live load of 40 pounds per square foot. Built by Port Authority engineers, the platform cost $21,000.

The first flight from this rooftop was made on May 31, 1951, with a



MECHANIC *Reece Mitchell (left) and Pilots Sam Chevalier and Ray Chaisson check out one of Port Authority's Bell helicopters for inspection at LaGuardia Airport*

used Bell 47-D1 helicopter purchased for $24,850. It logged over 1,000 hours and carried about 2,000 passengers before it was replaced in the summer of 1953 by two new Bell 47G's.

The 'copters are equipped with float-type landing gear, because most of our flights are made over water areas surrounding Manhattan. In this configuration, the 47G can carry 40 gallons of fuel, a pilot and two passengers. Its service ceiling, which we rarely have occasion to approach, is 11,000 ft and its practical range is three hours at a cruising speed of about 75 mph.

That range is infinitesimal when compared with the range of a fixed-wing business aircraft, but companies will find, as the Port Authority did, that it is not a limiting factor on a local transport helicopter operation such as ours. Although the New York-New Jersey port district is one of the largest metropolitan areas, no part of it is now more than 25 minutes from the Port office building. Therefore, the average flight in a PA 'copter is only about 15 minutes, despite occasional trips up to 100 miles distant.

However, the fact that 99% of the flights are so short creates its own problems. For example, we soon discovered that batteries will not last long if they are called upon to start a helicopter about 25 to 30 times a day. We get around that problem by maintaining booster battery units at the roof heliport and at other heliports used most frequently.

Of particular interest to the world of business and industry is another short-flight problem—accurate scheduling of helicopters. An ordinary company aircraft can be assigned to a particular mission for a day or a half-day and its "schedule" is complete. But a helicopter making many short hops each day must have a schedule worked out to the minute if it is going to be utilized efficiently and economically.

Scheduling and all other phases of our helicopter operations are handled in the office of the Airport Operations Division just two floors below the heliport on the roof. This office is equipped with two-way radio for communications with the 'copter pilots. It also has an anemometer and wind direction indicator. The man at the helicopter desk is, in effect, operating a control tower for the heliport above him.

The "tower" man also is in charge of scheduling flights and maintenance operations. He is a licensed A&E helicopter mechanic who can work with the regular mechanic at LaGuardia Airport on such major jobs as 25-hour checks and engine changes. When he is out of the office on such an assignment, one of the helicopters also is out of commission for the same period. That makes it possible for the pilot of the helicopter in the shop to take over scheduling and control tower duties.

A prospective user of helicopters in industry also will be interested in the fact that our scheduling of flights is entirely on a demand basis. There is a list of staff members authorized to use the helicopters and any of the 200 or more persons on that list can call operations desk to

PORTABLE *heliport tests pilot's skill. Float-equipped Port helicopters are landed on dollies and then hauled into the hangar at LaGuardia Airport at the end of each day's operations*

request a flight for a particular time. Some requests are made weeks in advance but most of the time they are made only a few days ahead. The schedule is usually full two days in advance, but important flights can often be scheduled on a few hours or even a few minutes notice.

When a staff member calls up to be placed on a schedule, he states where and when he wants to be picked up, where he wants to go, and whether the reservation is for one passenger or two. If there is an opening in the schedule at the time requested, the request is granted automatically, although the man on the schedule desk may suggest a slight change in take-off time to get a quick turn-around for the 'copter and to avoid gaps in the schedule or dead-heading. If neither machine is available at the time and place requested, an attempt is made to accommodate the staff member at another mutually agreeable time.

Naturally, there are frequently more requests for flights at a particular time than there are helicopters. In such cases, the man on the desk makes no attempt to decide which request is more important. He simply makes up his schedule on a "first ask, first served" basis and leaves it to the staff members concerned to resolve any conflicts and advise him of changes.

Important in our helicopter system and important to anyone contemplating an operation such as ours is extremely tight scheduling. This means that schedules must be adhered to as rigidly as wind, weather and other physical factors permit. Staffers who use the Port helicopters know this and are usually right on time for their scheduled hops. As a result the helicopters often sit down, deposit two passengers, pick up two more who are waiting and take off again without having their engines stopped or spending more than a minute or two on the deck.

A majority of the flights which keep our helicopters so busy involve time-saving personnel trips. An engineer from the main office has to look over a construction project; a man from the real estate department must confer with one of his tenants; a facility manager must make a quick trip to the main office to attend a conference; a man from the port development department has an airplane to catch for Washington; one of our traffic experts has a problem to discuss with the manager of George Washington Bridge.

These are types of trips which are part of the daily routine of any large organization with plants and offices scattered around a single metropolitan area or in two adjacent metropolitan areas. The Port Authority's experience proves beyond doubt that helicopters can be used to make such trips more convenient and to save untold man-hours of valuable executive time by cutting down desk-to-desk time.

The nature of the time saving is shown in the following table of travel times from the PA building at 8th Avenue and W. 15th Street:

	Driving Time	'Copter Time
Newark Airport	25 min.	10 min.
N.Y. Int'l Airport	45 min.	25 min.
LaGuardia Airport	30 min.	10 min.
Lincoln Tunnel (N.J. side)	15 min.	3 min.
Bayonne Bridge	40 min.	20 min.

Most spectacular of all will be the time saved by a helicopter trip to the Hoboken-Port Authority piers, which are directly across the Hudson River from the PA building. Without serious delays, it takes about 25 minutes to get to the piers by automobile. As soon as a heliport is available there, the 'copter will be able to make the trip in just *one* minute.

In addition to flights which have the simple mission of getting someone from one place to another, helicopters perform a variety of special functions. They are extremely useful for inspection and observation flights of all types.

Staff traffic experts have learned much about the traffic flow by watching it from a helicopter. Engineers and top staff personnel have found that a hovering 'copter is an admirable platform from which to inspect the site of a construction project, especially when the site is in a remote corner of a large airport. Trade promotion personnel have found that a 20-minute port inspection by helicopter can show a foreign or domestic shipper or other important visitor the numerous advantages and tremendous scope of the port of New York far more vividly than hours of talk or reams of literature. The helicopters also serve as valuable vehicles for Port Authority photographers who must record construction progress, take aerial photos to be used in planning new projects, or get dramatic photographs to be used in promotional material.

These are regular missions, but the helicopters have performed many odd jobs. They have carried high-priority mail, helped to discover stolen property near New York International Airport, aided police in cornering car thieves hiding in tall grass near Teterboro Airport, discovered and reported grass fires, chased wild dogs, and flown medical supplies to the scene of a disaster.

The heliports which enable the PA pilots, Marcel (Sammy) Chevalier and Raymond A. Chaisson, to perform these missions vary from the specially built platform atop our downtown building to a simple plot of grass near the Bayonne Bridge administration building. At George Washington Bridge, the heliport is the roof of the administration garage on the Jersey side. At Lincoln Tunnel, it is the administration building

CURTISS-WRIGHT'S *Harold Warden (center), general sales manager, Propeller Division, leaves copter with Herb Fisher and Pilot Chevalier after landing on Port Authority roof*

roof, also on the Jersey side. In Manhattan, there are heliports at Pier 41, East river and Pier A near Battery Park. Landing places on the ground also are available at Port Newark, International, Newark and Teterboro airports. But the most unusual "heliports" are the 12 x 16 ft dollies on which the 'copters land at LaGuardia Airport when they are to be towed into the hangar. These dollies are necessary because the helicopters have float-type gear and can neither taxi nor be towed when they are on the deck.

Although the two Bell helicopters do not usually land on water, mainly because salt water operations present corrosion problems, pilots Chevalier and Chaisson fly over water whenever possible. They are always aware of the value of large areas of water as emergency landing areas and manage to stay within auto-rotation gliding distance of water most of the time. They do not cross a congested area, such as Manhattan, without attaining sufficient altitude to enable them to reach either river or Central Park safely in case of a forced landing.

As an additional precaution, our pilots practice power-off auto-rotation landings frequently so that they maintain a high proficiency in handling their craft. The value of this practice was illustrated about a year ago when one of the 'copters enroute to Manhattan from International Airport developed a rough engine. Pilot Chevalier simply cut his engine and sat down on the water near the Brooklyn shore in the lower bay. This was the first and only forced landing in three years and the pilot settled down so smoothly his two passengers didn't know, until he told them, that anything unusual was happening. His trouble was a stuck exhaust valve.

The practice of staying near water or other open areas is only one of many operational procedures followed in making the Port Authority helicopter operation as safe as possible. And, as a matter of policy, operations are conducted only during daylight hours and only when the ceiling is above 500 feet and visibility is one mile or more. Operations from the roof-top heliport downtown are suspended whenever winds get above about 25 mph (depending on the gust factor) and operations from ground level are suspended when the winds are stronger than 40 mph.

Another safety precaution is proper maintenance. A licensed A&E helicopter mechanic is stationed at LaGuardia to check the helicopters before they start their rounds each morning. In addition to these daily checks, a rigid schedule of preventive maintenance is adhered to. A 25-hour check is a visual inspection of the helicopter, with a particularly close scrutiny of a few items specified in the erection and maintenance manual and a complete relubrication. In addition, oil and spark plugs are changed. This check takes about four man-hours. The 100-hour check includes closer inspection of certain items, relubrication of some additional points and replacement of tail rotor hub bearings. It takes about eight man-hours.

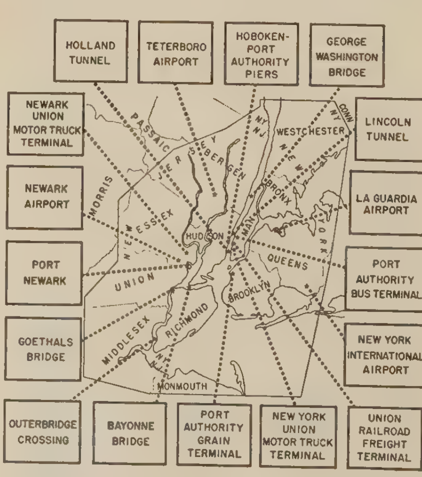


CHART *shows types of facilities covered by the two Port Authority copters*

The 300-hour check is a repetition of the 100-hour, with the addition of 100% visual inspection of the rotor craft parts and a top overhaul of the engine. It requires about 78 man-hours. The 600-hour inspection requires a complete disassembly of the rotor craft parts and a magnaflux inspection of all steel parts and a zyglo inspection of all dural parts. Bell's manual also specifies a major engine overhaul as part of this inspection.

This inspection is accomplished with a minimum of down-time, by keeping a spare engine on hand. The one removed can be overhauled before the next helicopter is ready for its 600. The tail rotor blade also is replaced as part of the 600-hour check, which takes about 240 man-hours.

What does all this cost? Most recent figures show that the direct fixed operating cost for the Bell 47G can be expected to average $9.86 per flight hour, broken down as follows: Engine overhaul at factory, $2.38; spare parts, $3.28; gasoline (@ 13 gals per hour), $3.90; oil (@ 3/4 qt. per hour), .30 cents.

Indirect operating costs will, of course, depend upon salaries paid to personnel, the type of operation, the number of hours flown per year, the particular type of operation and its management, and other factors. The best estimates on labor place it at $3 to $4.50 per man-hour, if maintenance is sub-contracted. The Bell 47G requires one to two man-hours per flight hour. Maintenance can thus vary from $3 to $9 per flight hour. Other figures may result if staff maintenance personnel is used and will vary also with the number of hours flown.

Pilot costs per flight hour also depend upon hours flown and pilot salaries. Going rates are $6,000 to $9,000 per year. Insurance and depreciation costs also vary widely. The Port Authority's experience with its 'copters, which must meet unique

(Continued on Page 46)

by Richard F. Porter
Wright Air Development Center
Wright-Patterson Air Force Base

Automatic Flare-Out Control

Paper presented at ARDC Science Symposium details results of tests in development of automatic flare-out control for landing

One of the major obstacles to the achievement of successful flight operations under adverse weather conditions is the difficulty of accomplishing successful landings. The desirability of truly all-weather flying, both from an economic and a military standpoint, is obvious. However, the necessity for certain minimums of ceiling and visibility so that the pilot may safely land his airplane, has greatly limited flight under these unfavorable (and frequently encountered) conditions.

This unfortunate situation has been aggravated by the advent of aircraft with higher landing speeds operating on runways of somewhat marginal length. A pilot making an instrument approach under conditions of extremely low visibility or low ceiling has very little time to take over control of the aircraft using visual ground references and land his aircraft with ample runway distance remaining for a smooth stop. The possibility of human error with disastrous consequences is high under these circumstances.

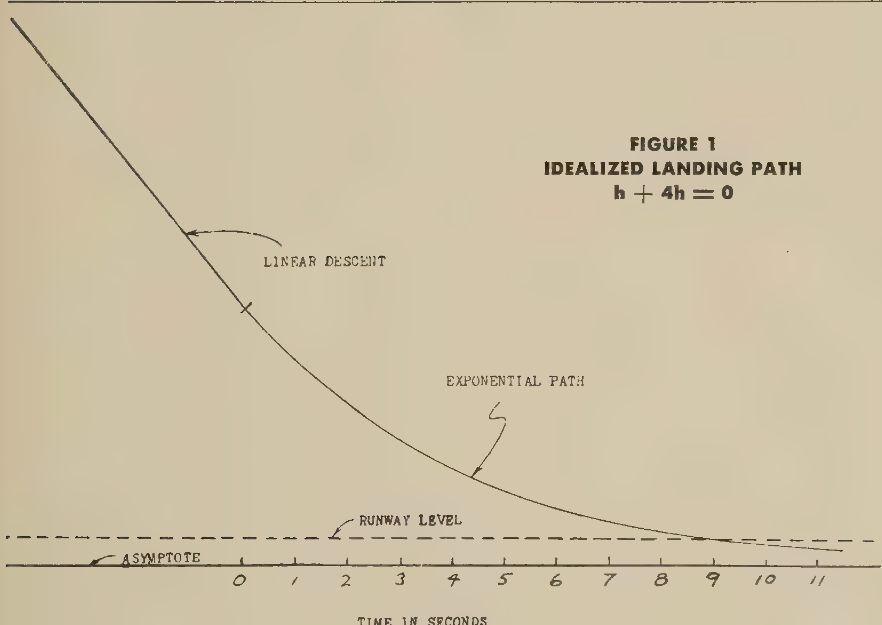


FIGURE 1
IDEALIZED LANDING PATH
h + 4h = 0

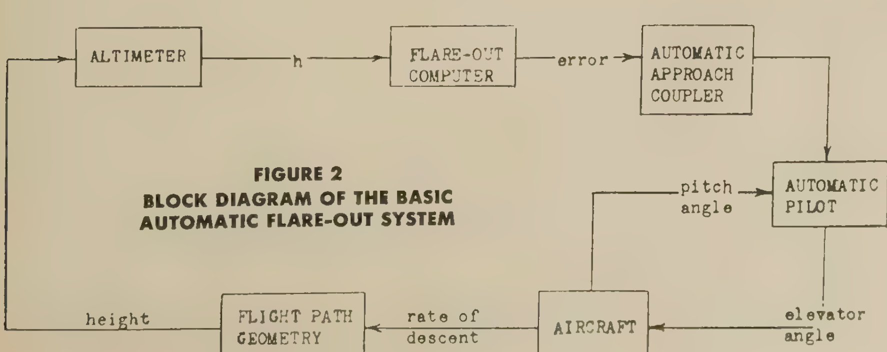


FIGURE 2
BLOCK DIAGRAM OF THE BASIC AUTOMATIC FLARE-OUT SYSTEM

The development of a fully automatic landing system in which the pilot acts only as a monitor of the controlling equipment would not only extend the present weather minimums to conditions of absolutely *no* ceiling or visibility but would increase the safety and reliability of operations under less adverse conditions. Such an automatic landing system would assume control of the aircraft several miles from the runway, guide the aircraft along the proper approach path at the correct airspeed, flare the path of the airplane to insure a good landing, and maintain lateral guidance of the aircraft along the runway until a full stop was accomplished.

For the purposes of this article, we will be concerned only with the actual landing phase.

Automatic landings have been accomplished with a C-54 aircraft and, more recently, with a high performance jet aircraft, the T-33. These tests, conducted by the All-Weather Section, Wright Air Development Center, have been most encouraging, although much work remains to be done before the automatic flare-out problem can be considered solved.

Our purpose here is to outline the basic theory of automatic flare-out control for landing, to show some of the results of analytical and simulator work that has been done, and to discuss the actual flight testing of the equipment.

Landing Criteria

It is first necessary to specify the quality of the landing we wish the aircraft to perform while under automatic control.

Perhaps the most important requirement for a smooth landing is

that the rate of descent at touchdown be small. It is considered advisable to contact the runway with a sinking speed below three feet per second.

In addition to this specification, the aircraft should touch down in a nose-up attitude sufficient to prevent the nose wheel from striking the runway before the main landing gear touches.

Assuming the rate of descent at touchdown to have a fixed value, it will be shown later that the requirement for pitch attitude mentioned above establishes the maximum touchdown airspeed that can be used. As a result of the interdependence of airspeed, pitch attitude, angle of attack, and rate of descent, the minimum airspeed at touchdown that can be tolerated may be established by either the stalling angle of attack or by the requirement that the pitch attitude be kept low enough so that the tail of the aircraft does not scrape the runway.

In addition to these considerations for control in the vertical plane, the effects of a wind velocity at some angle to the runway must be considered.

Generally speaking, there are two methods of maintaining an approach path aligned with the runway in the presence of a crosswind. The first of these is to hold the upwind wing low, thereby establishing a sideslip relative to the wind while preserving the desired ground-path direction. The second method is to head the aircraft slightly into the wind, creating a so-called crab angle with respect to the path over the ground. In either case, the aircraft should touch down with the wings level; and if the aircraft is not equipped with castering landing gear, the nose of the aircraft should be aligned with the runway with as little cross-runway ground velocity as possible so that side loads on the landing gear are minimized.

Another criterion for a good landing is that the runway distance consumed before touching down should be relatively small, assuring ample braking distance.

Path for Automatic Landings

At the present time, instrument approaches for landing during inclement weather are made by following a straight radio beam or path which intersects the runway in a vertical plane, and which is aligned with the runway in a horizontal plane.

With the standard ILS now in use, the aircraft is flown down the approach beam either manually or by automatic means. This beam is in-

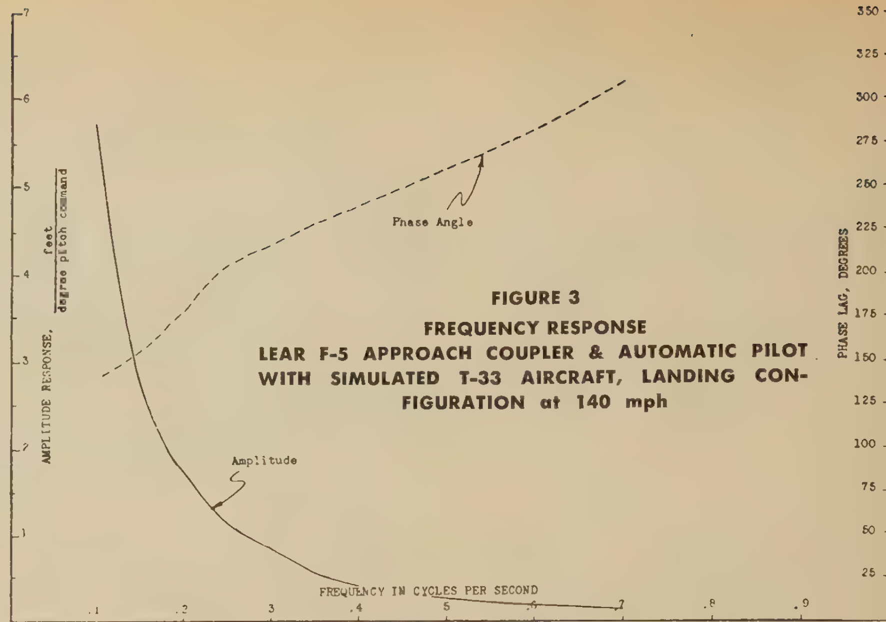


FIGURE 3
FREQUENCY RESPONSE
LEAR F-5 APPROACH COUPLER & AUTOMATIC PILOT WITH SIMULATED T-33 AIRCRAFT, LANDING CONFIGURATION at 140 mph

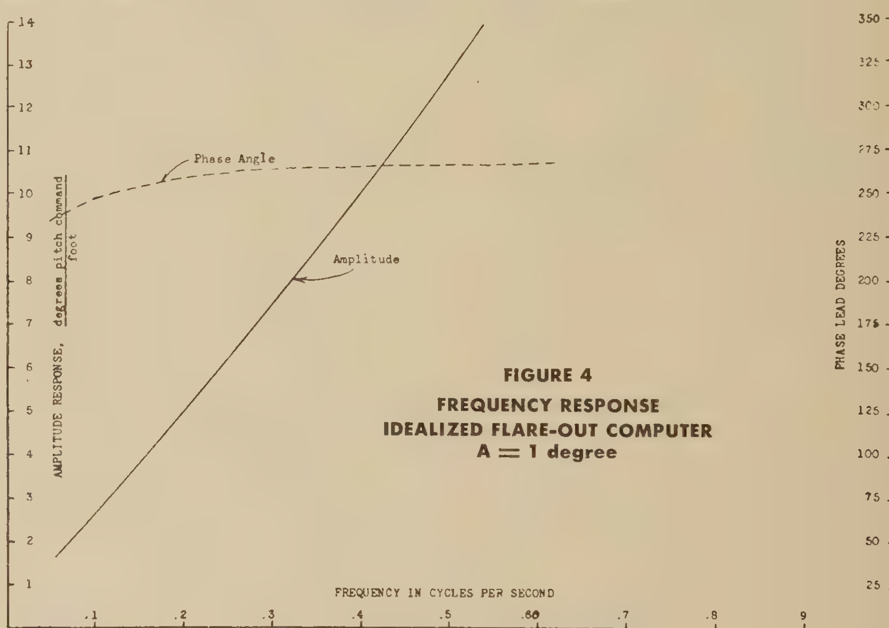


FIGURE 4
FREQUENCY RESPONSE
IDEALIZED FLARE-OUT COMPUTER
A = 1 degree

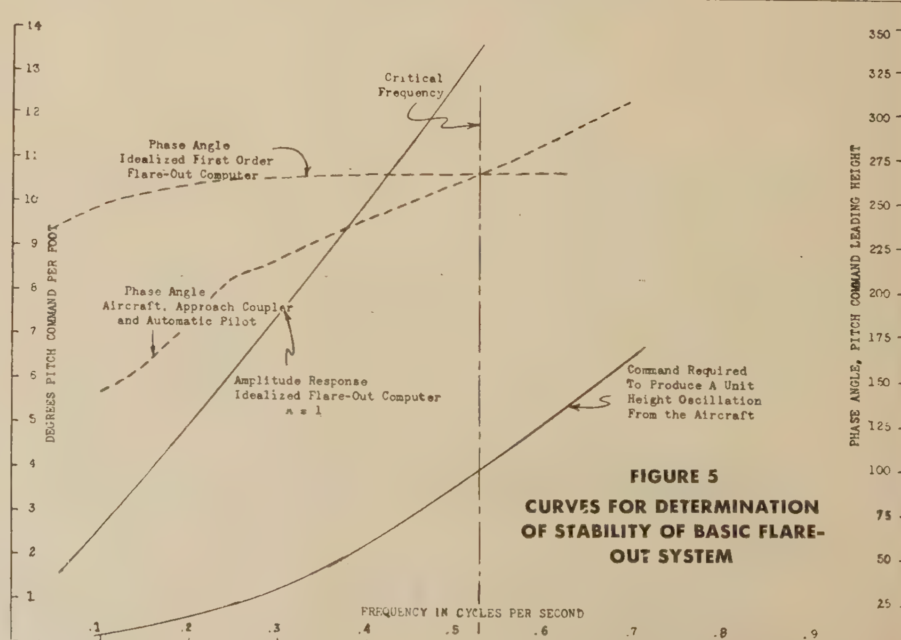


FIGURE 5
CURVES FOR DETERMINATION OF STABILITY OF BASIC FLARE-OUT SYSTEM

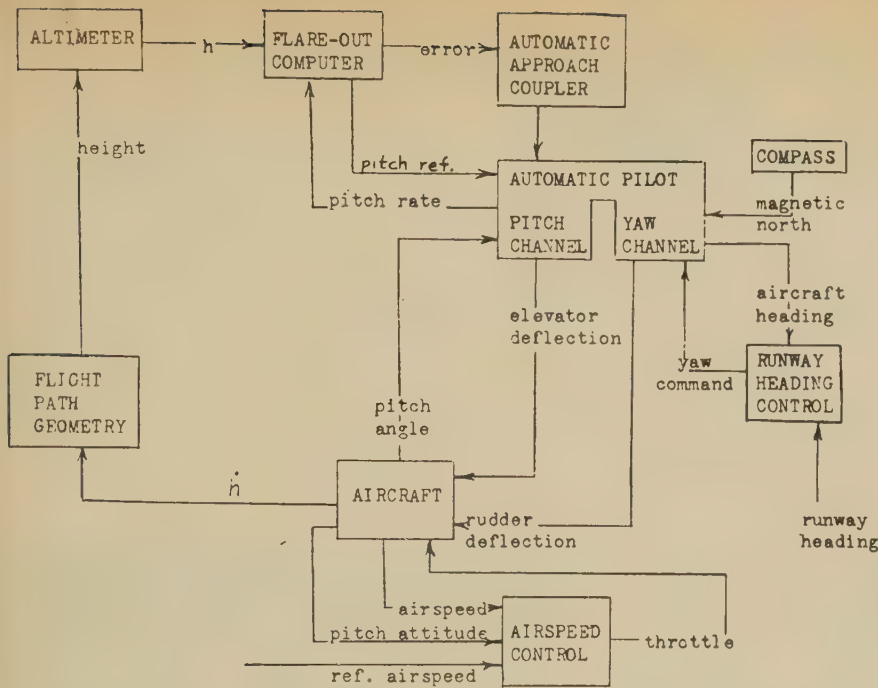


FIGURE 6—BLOCK DIAGRAM OF COMPLETE AUTOMATIC FLARE-OUT SYSTEM

clined to the horizon at an angle of 2.5° or more. The rate of descent of the aircraft is then directly proportional to its approach speed; with modern high-speed aircraft, this rate of descent is in excess of 500 fpm. The impact at touchdown will, therefore, be severe unless the path is changed to reduce this vertical speed. It is impractical to lower the approach beam any further because of terrain clearance and radiation problems. The apparent solution to the rate of descent problem is to flare the later portion of the landing path.

The shape of the flared path is a rather arbitrary thing since there are an infinite number of paths which conceivably could be used in changing the rate of descent, pitch attitude, and airspeed from the initial values existing during the approach to the final values specified at touchdown. However, in addition to the path requirements, other factors influence the selection of the path to be used.

Two of the more important considerations are:

(1) The maximum curvature of the path should be small; *i.e.*, there should be no sharp bends in the commanded path. This is important, not only because of the low airspeed of the aircraft relative to its stalling speed, but also for psychological reasons.

(2) The curvature of the path should have its maximum value early during the flare, since then the airspeed is higher and there is greater margin for possible path errors.

In view of these requirements, the path that has been selected is an exponential curve, asymptotic to either the runway itself or to some reference level a short distance below the runway.

The simplest differential equation describing such a path is:

$$h + K\dot{h} = 0 \qquad (1)$$

From this,

$$\dot{h} = -\frac{1}{K}h \qquad (2)$$

If we select a touchdown rate of descent of one foot per second, it can be seen that the asymptote should be placed K feet below the actual runway level. Touching down at this finite rate of descent is desirable; if the asymptote and the runway level coincide, the runway distance covered before touchdown may be excessive.

The initial rate of descent is fixed by the slope of the approach path and the approach airspeed. From equation (1), we may conclude that the initial height is directly proportional to K. The best value of K is thus a compromise between a sudden change of rate of descent and an excessive time required to contact the runway.

A value of $K = 4$ seconds has been used for almost all of the work done by All-Weather. This results in an initial height of 35.8 feet (31.8 feet above the runway with the asymptote set 4 feet below the runway) and a total of 8.8 seconds for the flare-out, assuming an approach of 140 mph on a 2.5° glide slope beam.

If an ILS glide slope beam is being used for the approach, it has been found that dynamic instability problems present themselves if an attempt is made to follow the glide slope beam to within 80 feet of the ground. This is a consequence of the converging shape of the beam with the subsequent increase in sensitivity to linear displacements from the beam centerline as the aircraft nears the transmitter. For this reason, it is necessary to uncouple the aircraft from the ILS glide slope beam at some greater distance from the intersection of the beam with the runway. The automatic flare-out equipment will then assume vertical control of the aircraft, establishing a fixed rate of descent until the altitude is reached where the exponential path is to begin.

To summarize, the path for automatic flare-out landings that we are considering consists of a linear descent from about 100 feet to 30 feet, followed by an exponential flare with a time constant of four seconds. This path is shown in *Figure 1*.

If the landing aircraft suffers a large and sustained displacement from its original path, because of a gust or other disturbance, it is preferable that a new exponential path be followed without an attempt being made to return to the original track in space. This is particularly true for errors above the intended path, since an obviously undesirable sharp nose-down maneuver could be caused by such an error.

Basic Automatic Flare-Out

We will assume that the aircraft is equipped with an automatic pilot and an automatic approach coupler, in addition to the other equipment necessary to accomplish automatic landings.

The automatic approach coupler is the device which receives signals from the ILS receivers in the aircraft and transmits these signals as commands to the automatic pilot during an automatic approach. This equipment is, of course, an integral part of the automatic approach system. It is logical, then, to employ this same equipment for the automatic flare-out system.

Since an exponential path for the flare-out requires that the rate of descent be adjusted as a function of absolute height, a radio altimeter of high accuracy is required.

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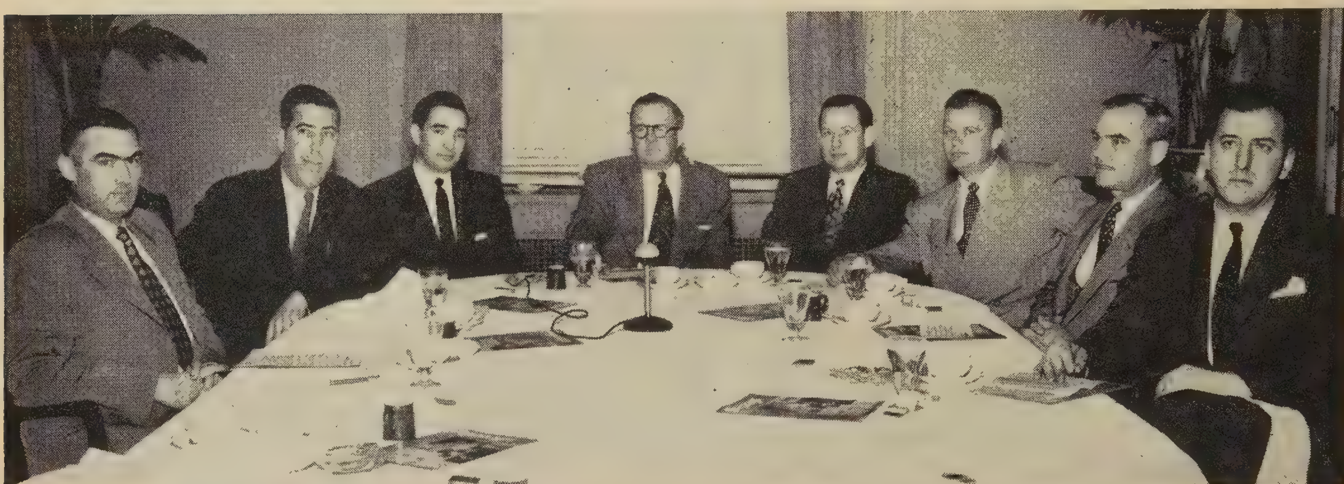
Current Air Transports for Business Flying



PILOT PARTICIPANTS *at the Round Table on the feasibility of using such transports as Convair 240, Martin 404 for business flying included (left to right) Bill Person who served as Moderator; Rip Strong, National Dairy Products; Mel Rummel, Flight Safety, Inc.; George Pomeroy, Cities Service; Clint Bacastow, Aircraft Service; Steve Brown, Continental Can; Owen Mayfield, Hercules Powder; Elliot Stark, an observer. Harold Terrington of Union Carbide & Carbon, joined the group few minutes later*

Moderator Wm. Person *(Transport Section, Flight Safety Foundation):* "As everyone knows, efforts are currently being made to encourage aircraft manufacturers to come up with transport designs aimed specifically to meet the requirements of business-aircraft users. Assuming such designs were definitely destined for production, it would take a period of at least five years to get those aircraft in the air as business transports. Building a new airplane involves many problems, not the least of which is the cost of engineering, and the airplane has to undergo a shake-down period during which all possible 'bugs' are eliminated. All of that takes time and money.

"Therefore, the problem to be discussed today is, 'Is it feasible for business-aircraft operators to utilize present-day transport types during the interim period between now and the day when a specifically designed business plane is available?'

"A number of fleet operators as well as several one or two-airplane operators have expressed interest in the Convair 240's and 340's that are presently available. I have some basic Convair operating-cost figures which I would like to toss out for your consideration. Assuming a Convair is operated 500 hours per year, its direct operating cost runs around $200 an hour. That includes cost of fuel, oil, repairs, overhead, landing fees, buffet service, and crew traveling expenses, plus an extra 10%, plus or minus. Fixed costs, such as crew salaries (and on the Convair a crew of three would be considered necessary), insurance, hangar costs, new materials and supplies, run about $150 an hour. Assuming amortization over a five- or three-year period, depreciation would run a couple of hundred dollars an hour. All this gives us a total of $500 or $600 an hour to operate a Convair.

"In that one hour of operation, the Convair would cover approximately 30% more ground than a DC-3 or a Lockheed *Lodestar*. It also would carry 14 or 15 passengers over a range of 1500 miles, and still retain sufficient reserve for instrument ap-

"NO ONE *type aircraft answers business needs," reported George Pomeroy (right)*

proaches, flight to alternate airports, and various other requirements the CAA imposes on operations.

"Having a 1500-mile range and being legal about it, is a new approach to the problem. Today, operating surplus and old airline aircraft within proper weight and balance with a passenger load and still carry the necessary fuel, is a problem.

"Steve Brown let's start this discussion with you."

Steve Brown *(Chief Pilot, Continental Can Co.)*: "We at Continental Can Co. have the same problem most business-aircraft operators have, namely, spare parts. The parts situation is becoming increasingly difficult, and if we continue operating pre-war or war-surplus aircraft, we eventually are going to have to pool our resources and go into the manufacturing business to get the parts we need.

"About a month ago, I had the good fortune of having C. R. Smith, President of American Airlines, on board. In the course of our conversation, I asked him what he was going to do with his Convairs, and he replied that when their DC-7's were in operation, they were going to have to dispose of some of their Convairs. When I asked about price, he said they would not hold up any prospective buyers on that. Since that conversation, I've heard that American has four Convairs on the market.

"Leonard Lee, who is in charge of our maintenance, investigated the Convair situation with American Airlines and came up with quite an extensive list of statistics from the maintenance angle. Five of American's Convairs are known as non-standard airplanes. They are good airplanes but they have certain parts that are not completely standard with American Airline's fleet. American Convairs run in time from 12,000 hours to 27,000. According to C. R. Smith, they are in much better condition mechanically than when American Airlines originally received them from Convair. After Leonard Lee checked with American, he agreed that the planes were in good condition. Their props are Hamilton Standard and they have CA-15 type engines instead of the 83-A's. I might add here that Convair does not think much of the CA engines for corporate operations because you are limited strictly to sea level standard temperature for maximum output of 2400 hp (wet). The minute you get into warmer or even just humid air, you lose horsepower. Incidentally, all of American's airplanes have the high gross weight center section kits.

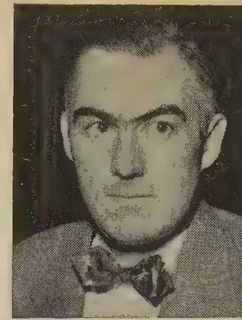
"Perhaps I should say here that the reason I'm talking first on the Convair 240 is because I believe it is still a modern airplane. It is a little faster than the 340, and I feel you could make a good executive airplane out of the 240 for less money than the 340.

"When C. R. Smith said they wouldn't hold up the public on price, I don't know whether he meant $250,000 or $350,000 apiece. Pan American sold four 240's to Northeast for $1,200,000 which totals out to $300,000 apiece. These Convairs had the CB-16 engines but they did not have the air-stair door. I found out from Convair that you can buy an air-stair door kit for about $15,-000. Personally, I'd rather have the CB-16's and then spend the money for the air-stair door and put it where I want it.

"Convair reported last week that KLM had some excellent Convair 240's for sale. They have no air-stair door nor CB-16 engines. Apparently, KLM was thinking about installing CB-16's but, due to the load factor, range and extra gross weight

OPERATION *of current air transports, according to Steve Brown (right, sitting next to Clint Bacastow), would bring about standardization of crew training and maintenance*

Round Table Participants



WILLIAM P. PERSON served as Moderator of the "Current Air Transports" meeting. Bill is Manager of the Air Transport Division, Flight Safety Foundation, and is a former American Airlines' pilot.

M. S. RUMMEL, Manager of Maintenance Engineering, Flight Safety, Inc., joined that organization in 1953 after serving as sales engineer for Bendix. Prior to that, he was engineer for Pan American.

OWEN MAYFIELD has been Chief Pilot for Hercules Powder Company since 1944. Before joining Hercules, he was flight instructor, crop duster and production test pilot. He is a graduate chemical engineer.

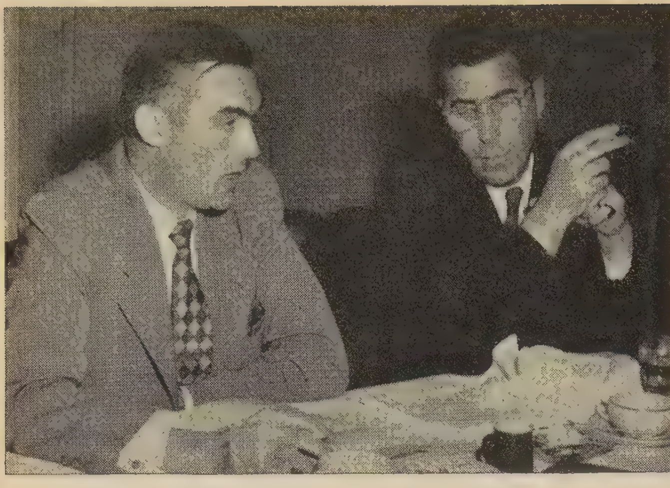
C. F. BACASTOW learned to fly in his college CPT program. He was a flight instructor and glider pilot during '41 and '42; and AF ATC pilot, 1942 to 1946, and became Chief Pilot, F. C. Russell Co, '46.

GEORGE C. POMEROY, Chief Pilot for Cities Service, holds ATR #990. He made his first flight in 1915; was enlisted pilot 1917-1924; flew mail, 1924-34; and flew for Air Transport Command, USAF, during World War II.

HAROLD TERRINGTON, Acting Asst. Chief Pilot, Union Carbide & Carbon Corp., is a former Pan American World Airways flight instructor and check pilot. During war, he served as Plane Commander, U. S. Navy.

STEVE BROWN, Chief Pilot for Continental Can Co., served with Air Transport Command in CBI theater during World War II. After the war, he joined Continental Can Co. and set up its Aviation Department.

WILLIAM R. STRONG joined National Dairy Products Co., Inc., in 1945, is now chief Pilot for that company. He is also Chairman of National Business Aircraft Association's newly formed Safety Committee.



"TOTAL COST *of operating a Convair," reported Bill Person (left, next to Rip Strong) "is from $500 to 600 an hour"*

"BEST PLANE *in the business for short-field, low-cost operation is DC-3," said Harold Terrington (right), Union Carbide*

they need, they are planning on buying new 340's instead.

"Pan American holds the engineering for a dump system for a Convair, and it is reported to be available at a very nominal price. The certification privilege is $3,000 an airplane to put CB-16's on a Convair 240. As far as the outer panels are concerned, this is a kit that sells for $45,000 and gives you an extra 550 gallons of gas. It also includes an oil tank kit in keeping with a 30-to-1 ratio of gasoline to oil. To make a 240 a useful airplane for an executive, I think it is necessary to have the additional gasoline. As far as I know, there have been only two 240's that have ever had the conversion kit installed on them. One is The Texas Company's, the other is the Ford Motor Car Company's. I understand it takes about six months for delivery on the wing tank kit from Convair.

"With respect to the 340's, there are still two Philippine Air Lines 340's available. They are now sitting in storage in San Diego, and can be had for $630,000. Consolidated is building 30 of these 340's on speculation. Wired for an A-12 autopilot and without any kind of an interior, each one is price tagged to sell for $655,000.

"There are some bitter aspects to this business, too, if you plan to use the Convair 240's that have the best operating pressurization system, the Stratos. You may have difficulty in converting from the CA-15 engines to the CB-16's. It takes a little more dishpanning around the firewall section and some sheet metal work. It probably has been done, but Convair wasn't up on this engine conversion.

"From a sales standpoint at Convair, they believe they are making progress with the turboprop 340. The military is very interested in it. With the turboprop 340, they are figuring on an easy 340 mph at 20,000 ft. If you bought a 240, there's no possibility of ever expecting to convert that airplane to turboprop power. Personally, I don't think you'd ever consider converting a 340 either. You'd probably go to a new airplane with the turboprop.

"To insure the longevity of our jobs and the jobs of the fellows working for us, we have to start thinking in terms of either new modern airplanes or a used airplane that is modern, and we must encourage our companies to start thinking that way. We've been very fortunate in the conversion of our 26. We talked the company into buying new CB-16 engines, and we also went to the latest type generators, etc., so that we could be interchangeable with either a Convair or a DC-6 on the engines.

"Naturally, money is the big thing. Right now I'm starting a program to try to convince our company that what we need to do is to sell our five airplanes and get four Convair 240's. It would bring about a standardization of crew training and maintenance; we could maintain and operate with current manuals; and we could attend ATA meetings that would keep us in touch with questions and answers to the problems all operators have with regard to the airplane. Right now we haven't anyone to go to with problems regarding some of our equipment, and what information is available is obsolete.

"We are all in this together, and whatever we can do to encourage our people to move in the direction of new and modern equipment should be done. The aircraft are available and I think we can prove to the companies we work for that we can buy a 240 and make a nice executive airplane out of it for around $150,000 or $250,000 less than a 340 executive airplane. I'd recommend the 340 for the wealthier companies, however."

Wm. Person: *"There are several things to consider in this business of using a modern-type transport for executive travel. One is comfort, involving the fatigue element. Today, if an executive wants to make a trip from A to B and then to the Coast, he's going to end up with an oxygen mask before he reaches his West Coast destination. Certainly, pressurizaton is a tremendous factor in the businessman's attitude about his flying. With pressurization you can climb above the weather. Without pressurization you just have to sit there and take whatever the weather offers. Standardization of a fleet is an economic factor, too. George Pomeroy, what are your thoughts?"*

George C. Pomeroy *(Chief Pilot & Gen. Mgr., Cities Service Oil Co.)*: "Pressurization is a big concern of ours. When we're flying our top people—the president or the chairman of the board—and we get into bad weather and have to sit down someplace, they immediately ask why we haven't pressurization. We're concerned about it because when they have to go coast-to-coast, they take the airlines. That doesn't look good for us.

"Right now we have about five different types of aircraft, and I don't think any one type is the answer to the question. You have to have at least two: one type for the top executives and another type for the lesser powers. A Convair or a Martin 404 would be a bit too big for us.

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Effect of Temperature and Humidity on Power Output

by Harley D. Kysor

Temperature and humidity and their effect upon engine power and airplane performance have been subjects of considerable discussion in recent years—and with good reason. At the relatively high gross weights at which current transport aircraft are licensed to operate, performance during the take-off frequently leaves something to be desired and little, if any, drop-off in engine power can be tolerated if any reasonable margin of performance is to be assured in engine-out emergencies. But power drop-off is a natural consequence of high atmospheric temperature or humidity and should be given due consideration when scheduling operations involving take-off power. To provide some basic facts on the subject, this article will attempt to explain the reasons why power varies with temperature and humidity, and to present means of determining the approximate magnitude of such variations.

Basically, the problem revolves around the quantity of oxygen supplied to the engine. A reciprocating engine produces power by the combustion of fuel and air (oxygen) in its cylinders. The fuel usually is in the form of vaporized liquid which, if necessary, can readily be introduced into the cylinders in quantities far in excess of what is required for combustion. On the other hand, the maximum quantity of air that can be drawn or forced into the cylinders is severely limited by the aspirating or "breathing" characteristics of the engine. Other things being equal, the power produced by an engine is dependent upon the *weight* of oxygen contained in the air that is pumped through its cylinders. Temperature and humidity both cause a change of air and hence have a direct effect upon the engine power.

Let us first consider the effects of atmospheric temperature. Power output suffers with rising temperatures, primarily because of the decrease in air density that accompanies a temperature rise. The basic gas laws tell us that with an increase in temperature the density, or weight of a given volume, decreases in proportion to the absolute temperature. For a 10° F. rise above the standard sea level value of 50°F. the air density decreases by approximately 2% and the weight of the oxygen contained in a given volume of that air decreases accordingly. On the other hand, warmer air flows much easier through the carburetor, engine manifolding, valves, etc., with the net result that the loss in weight of the air delivered to the cylinder in the short time that the intake valve is open is only about one-half of what would be expected in view of the decrease in air density. Theoretical considerations, confirmed by dynamometer tests, indicate that at a given altitude, RPM, and manifold pressure, the power drop-off is approximately 1% for each 10°F. rise above the standard temperature. Thus, a DC-3 equipped with P&W R-1830-92 engines rated at 1200 BHP and taking off from a sea-level airport on a 90°F. day could expect a power drop-off of 3% of 1200 BHP, or 36 BHP per engine.

An additional effect of temperature on power output occurs in supercharged engines operated at full throttle. Supercharger efficiency or, more specifically, the boost in pressure that the unit is capable of delivering decreases as the air temperature rises. Thus, the maximum manifold pressure that can be obtained with full throttle on a hot day will be lower than the manifold pressure obtainable on a standard day, and the total power drop-off will be the combined decrease in power due to the lower manifold pressure and the decrease in power, at that lower manifold pressure, due to the change in air density. The magnitude of this full-throttle effect depends upon the supercharger characteristics together with the atmospheric and manifold pressures involved and, therefore, is difficult to generalize. However, for the P&W R-1830-92 engine a decrease in manifold pressure of approximately .25 in. Hg. results from a 10°F. temperature rise when operating at full throttle just above the critical altitude. Since each inch of boost on this engine produces about 25 BHP, a quarter-inch represents about 6 BHP and hence an additional loss of 6 BHP can be charged against our 10°F. temperature rise. More specifically, the power output at full throttle with a 10°F. temperature rise would be 99% of (1200—6) or 1182 BHP—a total drop-off of 18 BHP or 1.5%.

Before leaving the subject of temperature, it should be noted that atmospheric temperature also influences engine operating temperature which in turn influences power output in a manner similar to the density effect. However, evaluation of the magnitude of this factor on a particular engine requires knowledge of the temperature distribution among cylinders in much greater detail than is usually available in commercial installations. However, since the basic engine power ratings are established with the engine operating near the limit temperatures, let it suffice to say that a power drop-off may be expected when an engine is operated at a temperature above its limit values.

Turning now to the subject of humidity, let's first settle on just what we mean by "humidity"—or what we don't mean. Plain water in the air, in the form of rain drops or even the microscopic droplets that make up fog, does not of itself cause a drop-off in engine power. In fact, water in such concentrated form can be utilized under certain conditions to control the "explosion" of the fuel-air mixture at high manifold

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SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS

NEW MODEL 560 *Commander features swept tail for greater stability, increased controllability at low speeds. Cruise has been upped to 200 mph, maximum load to 6,000 pounds*

Aero Design & Engineering Co. Announces Swept-Tail Model 560

Oklahoma City, Okla. A new "swept-tail" model of the Aero *Commander* recently was announced by Aero Design & Engineering Co. Designated Model 560, it is believed to be the first non-military aircraft to adopt this feature which offers advantages in the way of greater stability and increased controllability, especially at low speeds.

Powered by two Lycoming GO-480-B geared engines, the 560's cruise has been stepped up to 200 mph (at 5500 lbs). Its top speed is 209 mph, and its service ceiling at the same gross (5500 lbs) is 22,000 ft. Under maximum load conditions (6,000 lbs), the ceiling with one engine feathered is 8,000 ft. At that same gross, its two-engine rate-of-climb at s.l. is 1400 fpm, and 325 fpm with one engine feathered.

Sea level power-off stall speed under maximum load, with gear and flaps extended, is 59 mph; sea level power-on stall at maximum performance category is 40 mph.

The new 6,000-lb gross load of the 560 provides greater utility and makes the *Commander* one of the few business-type airplanes capable of carrying a full load of passengers (up to seven) and still providing a cruising range of more than 1,000 miles.

FAF price for the Standard Model 560 has been announced at $69,500, including dual generators, an emergency exit, internal control locks and a tow bar. These items formerly were listed as optional equipment. Other equipment installed on the Standard Model 560 includes Hartzell all-metal full-feather props, a full set of blind flight instruments and a Lear LTRA-6 radio which incorporates a VHF transmitter and receiver and an LF receiver. Standard seating is the five-place version, with optional seating available at extra cost.

Passenger-wise, an outstanding feature of the new 560 is an optional seating arrangement which provides six-place "individual seating." This arrangement gives each of the six passengers "by the window" seating and enables passengers to move from one seat to another in flight. The *Commander's* reclining chairs are adjustable to three positions and are mounted on sliding tracks so they can be adjusted to the size and comfort of the occupant.

New interior styling offers owners a choice of four standard interiors done in high grade fabrics and in rich contrasting colors. Customer interiors done in genuine leather also are available.

First deliveries were scheduled for June.

Itinerant Flight Service Gives Promise of Improvement

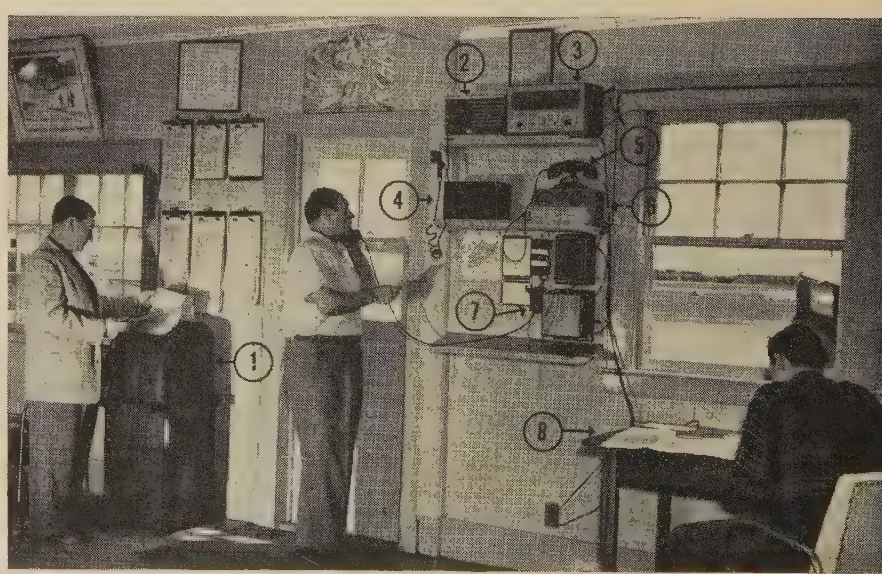
New York, N. Y. The Weather Bureau and CAA have reached an agreement to inaugurate ones-top pilot service at all combined communication station/tower locations. As fast as funds become available, uniform Information Displays and Facilities will be provided.

One feature is to provide an extension of the Weather Bureau telephone in the tower with a signalling circuit so that incoming calls to the WB from pilots can be transferred to the tower after the weather briefing is accomplished. The pilot can then file his flight plan with the Controller/Communicator in the tower on the same call.

Also, in a manner similar to the service provided by forward-looking commercial airport operators, an extension on the WB-Tower telephone circuit will be provided at the Airport Information counter used by pilots so that pilots visiting the weather office for in-person briefings can use it to file flight plans.

At the above-mentioned commercial airport operator locations around the country, some complaint has been noted concerning the infrequent use of the UNICOM service available. Pilots in turn complain that too many attempted calls are wasted effort. The solution lies in better planning on both sides.

The operator can increase the usage and customer satisfaction by arranging the location of his UNICOM equipment at a natural point for office or service personnel to monitor it and respond to calls without undue interference with other duties. Also, it should be placed in close proximity to the telephone and other



ZAHNS *facilities include 1) teletype, 2) Unicom, 3) forecast receiver, 4) line to CAA-ATC, 5) line to Republic tower, 6) wind velocity, etc., 7) line to INSAC, 8) plotting table*

facilities necessary to obtain operational or weather information for inbound pilot.

Another suggestion is a prominent sign on the flight line advising of the existance of the UNICOM service. This could very well serve to guide the taxiing-in pilot when line personnel find it difficult to drop some important detail in order to rush out to the arrival. The pilot in turn could make known his needs without the irritating round trips made by busy line personnel and airport management. An illustration of the compact set-up established at Zahn's Airport on Long Island, N. Y., suggests why this previously considered small out-of-the-way field suddenly has acquired a reputation for service and convenience among corporation crews and private pilots alike. This has been further augmented by the approval of an ADF radio beacon instrument approach procedure via the Babylon MHW-FM (see latest *Air Guide* and *IFR Manuals*). Landing minimums of 500 feet and one mile with radar transition from Idlewild is a boon to the growing number of commercial operators.

First Production Learstar in Series of Flight Tests

Santa Monica, Calif. The first *Learstar* off the Lear, Inc. production line has completed its first series of test flights.

Test pilot Les Coan and Chief Aeronautical Engineer Gordon Israel who has been acting as copilot report excellent flight characteristics and ease of handling, as well as exceptional performance. In one climb test, at 21,000 lbs gross weight, the *Learstar* went from a standing start at sea level to 10,000 ft in 5 min, 51 sec.

This Number One production airplane is the first to incorporate all the *Learstar* high-performance features, including the new streamlined panorama windshield, 1525-hp C9HD engines, and new nacelles with full closure gear wheel-well doors.

Aero News Notes . . .

New York, N. Y. Airponents, Inc., CAA Repair Agency No. 3591 (for Class 1 and 2 accessories) has moved to new and larger quarters adjacent to New York International (Idlewild) Airport. Now occupying their own building (over 5,000 square feet), Airponents has installed additional new test equipment for reverse pitch prop governors, Woodward and Eclipse type electric heads, and a test stand to take care of all type hydraulic variable displacement pumps. In addition, Airponents is an authorized overhaul agency for Bendix, Stromberg, Eclipse and Thompson, and is geared to handle the majority of components used in commercial and executive aircraft, including master controls for the R3350 and R4360 engines.

■

Wilmington, Dela. Stewart M. Ayton, vice president and general manager of Atlantic Aviation Service, Inc., recently announced the appointment of Bob Boswell as sales manager for Atlantic Aviation's newly opened branch at Philadelphia Airport. Boswell is an active airline pilot. Operations manager is Al Mosley.

....in the Business Hangar

Chuck McKinnon and John Powers delivered IBM's new Aero *Commander* to Reading Aviation Service for a major radio and instrument panel installation. Equipment installed on the *Commander* that will be flown by IBM's president, J. B. Watson, Jr., included Collins VOR and Communications system, Collins glide slope and marker beacon receivers, ARC omni receiver and VHF transmitter, Sperry Gyrosyn, Bendix ADF, and a Landing Speed indicator. Provisions also were made for future installation of a Collins Integrated Flight System and a Narco DME.

Tecumseh Products Co., Tecumseh, Mich., has replaced its *Lodestar* with a Remmert-Werner Super-92 DC-3 which carries Collins VHF communications and navigation equipment. Pilot of the 206-mph (cruising) DC-3 is Orville Bishop.

The D18S owned and operated by L. C. DeFelice & Son has been equipped with a Flite-Tronics MB-3 marker beacon receiver. Pilot for the North Haven, Conn., company is W. B. Pekar, and installation of the MB-3 was made by Usher Aviation, New Haven, Conn.

Parker Pen Company is flying a DC-3 recently converted by Aerodex in Miami. Chief Pilot Roy Coyle and his copilot, Bob Hanson, took delivery of the new executive -3 in Miami and then flew it back to Janesville, Wisconsin, where the aircraft is now based.

Spencer Chemical Company's Twin Beech sports a new custom interior done by Horton & Horton Custom Works at Meacham Field, Fort Worth, Texas, new home of H&H. Incidentally, H&H delivered 76 complete interiors in the twin-engine class alone during a 12 months period ending March, 1954, and the company is about to launch a new cleaning service for executive aircraft.

Union Oil Company has its new Convair 340 in service with Jim Stevenson, Chief Pilot, at the controls. Equipment aboard the plane includes Qualitron-installed custom cabin entertainment system, radio altimeter, Sperry A-12 autopilot and wiring provisions for a Sperry engine analyzer. Home base for the new executive 340 is Burbank, Calif.

Paul Butler's *Twin Bonanza* is flying again after installation of a Lear L-5 autopilot with automatic approach coupler and altitude control. Installation was made at Lear's Grand Rapids (Mich) hangar.

Jack Huth brought Island Creek Coal Company's *Lodestar* to the Idlewild facility of Lockheed Aircraft Service for a major.

International Paper Company's *Lodestar* has been in the hangar at Southwest Airmotive for repairs and 100-hour check. While overseeing the check, Chief Pilot Carl Lund reported that recent carburetor trouble turned out to be a bird's nest built over the *Lodestar's* airscoop during a stopover at LaGuardia Field, New York.

Precision Castings' newly acquired DeHavilland *Dove* has been in the Reading Air Service hangar, Reading, Pa., for 100-hour check and extensive radio work. This particular *Dove*, one of the best equipped in the country, was formerly owned by Kewanee Oil Co., and flown by Skip Wittner.

While Tom Neyland, Chief Pilot for Taylor Oil & Gas Co., Taylor, Texas, attended an NBAA Regional meeting in Dallas, his company's Twin Beech was in Southwest Airmotive's hangar for 100-hour check.

Old Dom Box Co. has added a Flite-Tronics CA-1 Audio Distributor Amplifier to its Cessna 195. Installation was made by Southern Flight Service at Charlotte, N.C.

Al Wagner, pilot for Heckett Engineering Co., Butler, Pa., brought his company's new Super-92 DC-3 to Remmert-Werner for installation of a Sperry Gyrosyn compass, Collins RMI and 17M1 transmitter, and direct-drive starters.

NATION-WIDE **SALES & SERVICE** ORGANIZATION

AERO DESIGN Commander 560

H. Leibee Wheeler, Buffalo Aeronautical Corporation, Buffalo Municipal Airport, Buffalo, New York

Robert F. Wood, Newport Air Park, Newport, Rhode Island

George Harte, Harte Flying Service Inc., Chanute Municipal Airport, Chanute, Kan.

Walter R. Crow, Walter R. Crow, Inc., Toledo Municipal Airport, Walbridge, Ohio.

B. G. Vandre, Van's Air Service, Municipal Airport, St. Cloud, Minnesota.

C. W. "Wayne" Crussell, Southern Aero, Inc., Municipal Airport, Atlanta, Georgia.

Cheston M. "Chet" Newhall, The Babb Co. (Canada) Ltd., Montreal Airport, Dorval, P.Q.

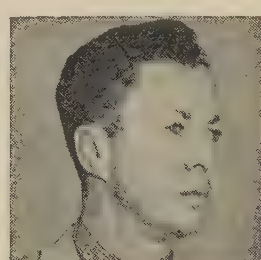
Art Meurer, Arthur Meurer Co., Inc., LaGuardia Field, New York, N. Y.

O. B. Callan, Sales Manager National Aero Sales Corp., Midway Airport, Chicago, Ill

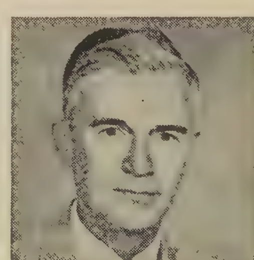
Don Hood, President, Air Sales & Service, Inc. Wier Cook Municpal Airport, Indianapolis, Indiana.

Peter Graves, Southern Ohio Aviation Company, Inc., Dayton Municipal Airport, Vandalia, Ohio.

Ray I. Wilson, Manager, Downtown Airpark, Inc., 1800 South Western, Oklahoma City, Oklahoma.



Don Vest, Vest Aircraft & Finance Co., P. O. Box 5306, Sky Ranch Airport, Denver Colorado.



H. Warren Holladay, Stonnell and Holladay, Easton Municipal Airport, Easton, Md.

Don Pennington, Carolina Aero Company, Asheville-Hendersonville Airport, Fletcher, North Carolina.

AERO DESIGN Commander

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AERO DESIGN AND ENGINEERING COMPANY

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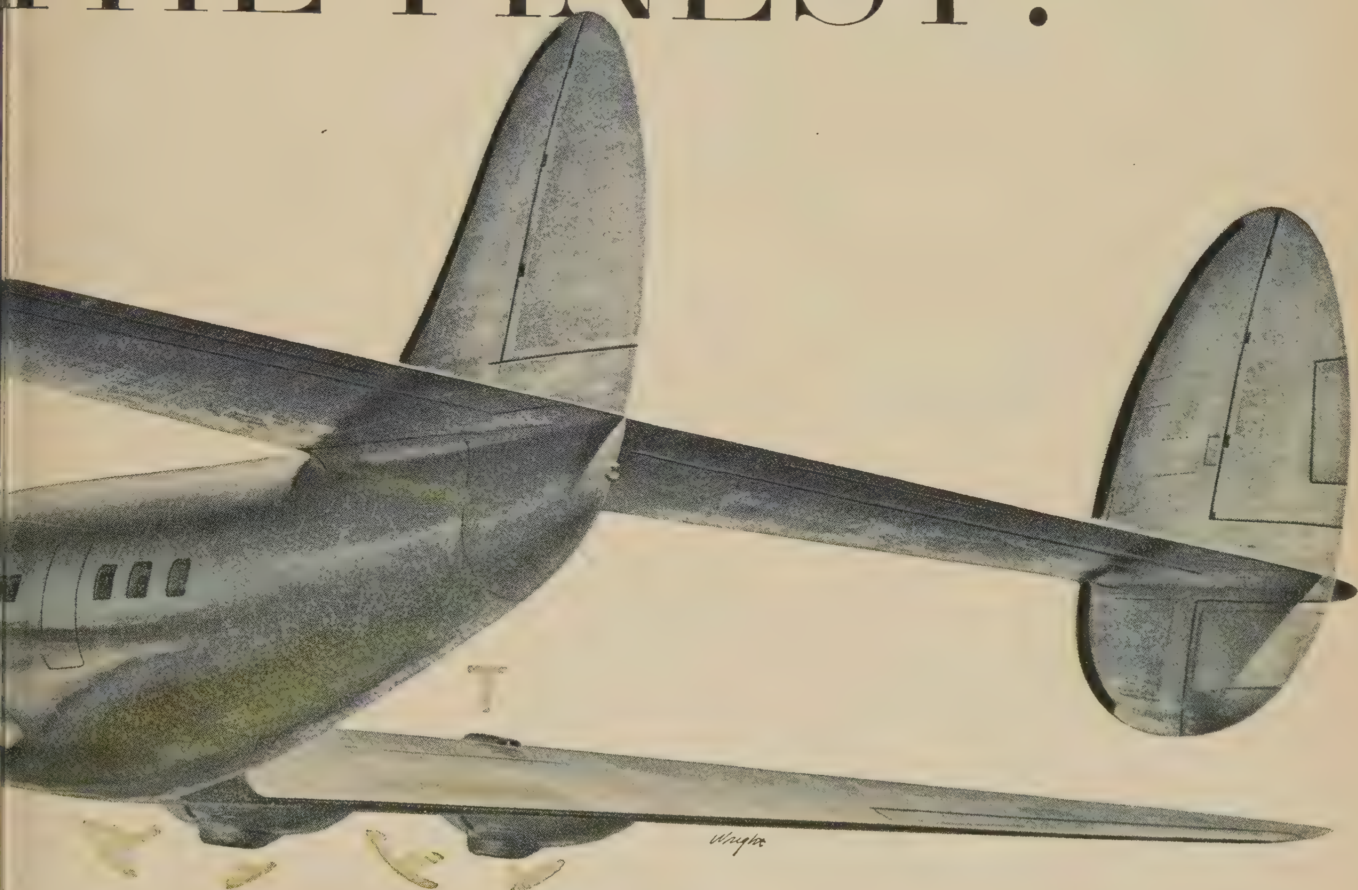
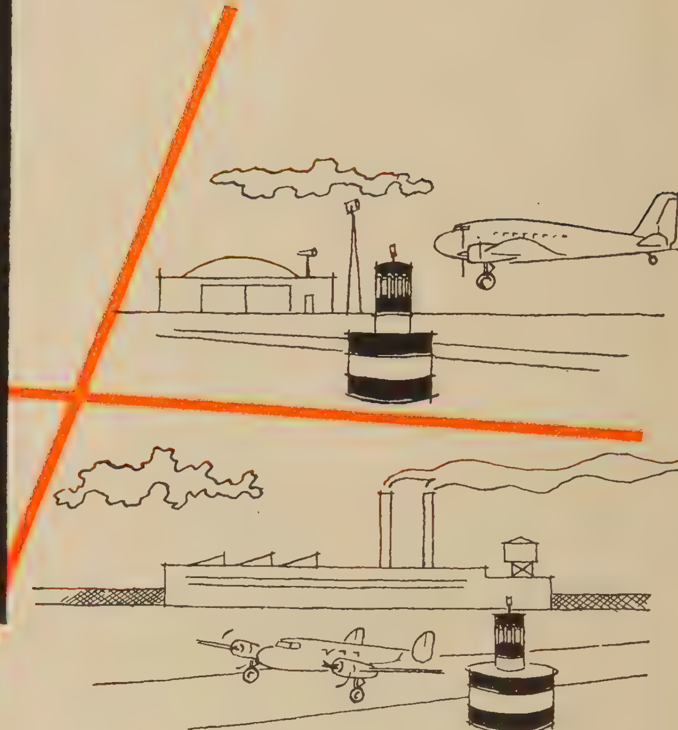


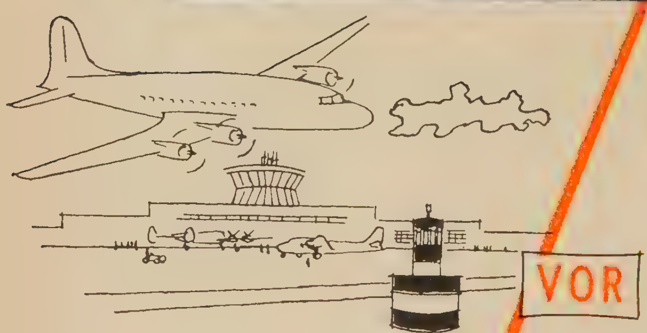
LOCKHEED

AIRCRAFT CORPORATION

BURBANK, CALIFORNIA, AND MARIETTA, GEORGIA

OCKHEED FOR LEADERSHIP



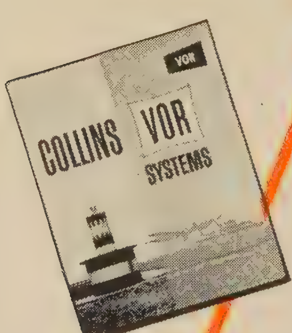


Low cost VOR stations

for any field — municipal, commercial or private

Completely dependable, *low cost* navigation-instrument approach facilities are now available to airfields everywhere. Collins easily maintained VOR stations allow airports to increase utilization and permit operations under weather conditions that might otherwise close the field. Internal monitoring systems permit checking of accuracy and operation by non-technical personnel. Collins VOR stations are designed for unattended service and remote control, if desired.

Write today and ask for the free booklet on Collins VOR systems. It will give you all the facts.



Send for this explanatory booklet today.

COLLINS

COLLINS RADIO COMPANY

Cedar Rapids, Iowa

11 W. 42nd Street, NEW YORK 36
1930 Hi-Line Drive, DALLAS 2 • 2700 W. Olive Avenue, BURBANK
Collins Radio Co. of Canada, Ltd., 74 Sparks Street, OTTAWA, ONTARIO

Proficiency Programs Hold Promise of Lower Minimums

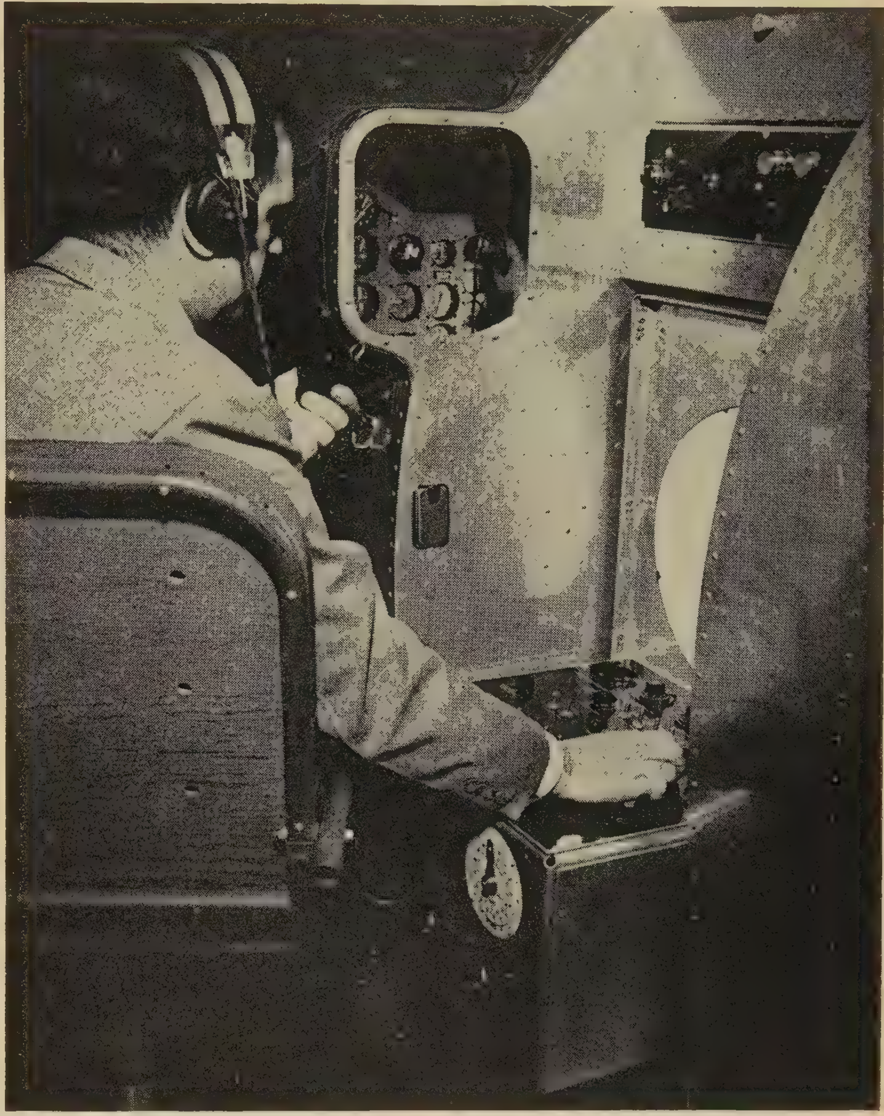
One of the problems confronting professional non-airline pilot crews where a fleet of aircraft are involved is the maintenance of pilot proficiency training programs. For the obvious reasons of safety of personnel and equipment, this factor is resolved by various corporations in differing ways. Many seek the services of long established commercial instrument flight schools; some, the more advanced over-all techniques of the newer equipment and flight proficiency organizations. Others rely on their own personal closed system of cross-checking.

A factor of comparable urgency to safety is the operational percentage of flight completion. Large expenditures to support one or more multi-engine aircraft and associated personnel is only justified if regularity of flight completion approaches that of the airlines. What the electronic flight duplicators and simulators have done for the airlines, they can do for the corporation aircraft crews as well. But more than that, they can be the means of qualifying crews to operate to landing minimums equal to the air carriers.

Many business aircraft crews are equipped and can easily demonstrate proficiency equal to accepted airline standards but, facing the problem of having to be expert in a universal sense rather than a route sense, it becomes readily apparent that it is impractical to "qualify" for air carrier minimums below those of the Flight Information Manual at every airport at which a crew might foresee making an approach.

Many business-aircraft crews in fleet groups already have faced this problem. The solution does not lie in just the best of available equipment and maintenance programs, nor in pilot proficiency at any one moment of demonstration, but rather *in a consistent program* of training and proficiency checks comparable to that which supports air carrier minimums.

Such a program involves not only check-pilot standards of high caliber but also, in view of the high use potential of corporation aircraft, ground equipment fully acceptable in the terms of the latest Civil Air Regulations as a basis for consistent training and flight proficiency of air carrier standard.



CURTISS—WRIGHT MODEL 501 INSTRUMENT FLIGHT DUPLICATOR

The Instrument Flight Duplicator as C-W calls its Dehmel Model 501, in use by the hundreds in the Armed Services and airlines, is the best instrument, short of the individual aircraft-type simulator, for achieving this end that is available to business aircraft crews. It has come to light that C-W's Carlstadt, N. J. plant shortly will have available for order, four of these flight duplicators at a negotiable price. Ordinarily unavailable outside of large contract orders, this availability should be attractive to organizations that have previously thought them out of their economic reach. Based on a large production run being completed for a purchaser, one or all four of the Model 501 can be obtained in a few months' time—*if* ordered now.

RTCA Reports Medium Frequencies Opened to Multi-Channel Use

Most pilots have adjusted to the idea of 180-360 channel VHF radios; although they are not too happy with the loss of range (beyond line-of-sight) so happily associated with medium frequencies. Now, the Radio

Technical Commission for Aeronautics has issued a report which analyzes the advantages and problems of development of a single sideband aeronautical radio-telephone system for air-ground communication in the medium-high frequency (2,000 to 24,000 kc) radio-frequency band.

Such a system, according to RTCA, would increase the number of usable frequency channels and maintain the reliability of air-ground radio-telephone communications with decreased transmitter power output.

These two advantages are described by RTCA as follows:

1. The single sideband method of transmission would make available approximately twice as many channels in the aeronautical radio-frequency spectrum as can be realized with double sideband techniques.

2. Efficiency of the over-all signal transmission would be improved as a result of the reduction in interference effects and the greater utilization of transmitter capability.

A rapid increase in the number of frequency channels required for air-ground communication is anticipated within the next few years. The economical frequency spectrum requirements of single sideband communication may be the deciding factor in its future implementation.

The report also recommends the establishment of design criteria for the single sideband system for standardization purposes.

Copies of the report by Special Committee 65 (Paper 11-54/DO-53) are available from the RTCA.

Air-Aids Spotlight

AKRON, O.—*The re-aligned SW/NE courses of the Akron LFR (021°/205°) eliminates Blue Airway 15 between Akron and the East course of Cleveland, provides Blue 81 now via Adamsville and Parkman to Amber 6, providing lateral separation and simultaneous use of V-43.*

ALLENTOWN, Pa.—*ILS Commissioned on 110.1 mc and 334.1 mc, lowers airport minimum to 400 feet—¾ miles. LOM on 224 kc, serves Runway 6.*

AMITYVILLE, N.Y.—*Zahn's Airport ADF approach from Babylon MHW with radar transitions via Idlewild Approach Control.*

COLORADO SPRINGS, Col.—*LF Range on 224 kc decommissioned, voice communications service now on Outer Compass Locator (Class MH) on 239 kc "CO".*

HUNTINGTON, W. Va.—*BH facility now on 323 kc.*

IDLEWILD, N.Y.—*VOR commissioned on 117.2 mc.*

LONG BEACH, Cal.—*VOR relocated on Los Alamitos NAS field without change of frequency, code or identification.*

NIAGARA FALLS, N. Y.—*ILS freq. changed to 108.1 mc. AF radar assistance available on request at this civil field, as at Dover, N. J. and Wilmington, Del.*

TETERBORO, N. J.—WESTCHESTER, N. Y.—*Swap ILS frequencies of these two airports: TEB now 109.7 mc; Westchester, 108.1 mc.*

TRENTON, N. J.—*Mercer County Tower operating on 121.3 mc, 121.5 mc, 121.9 mc, 126.18 mc, Receives on all the above, plus 122.5 mc and 3023.5 kc.*

YAKIMA, Wash.—*ILS commissioned on 110.3 mc and 335.0 mc, "YKM", Outer Compass Locator on 284 kc, "YK", Middle Locator on 203 kc. System serves dog-leg approach to airport.*

Correction

WILLIAMSPORT, Pa.—*Air-Aids report should have read WILKES BARRE, Pa. (June issue)*

WINSTON SALEM, N. C.—*Our agent advises us it is not true that ILS LOM keys "LS" and the LMM keys "MFT" (also June issue).*

Pictorial Gyro Eases Attitude Recognition

With pilot reaction time becoming more critical as aircraft speeds increase, the new Lear Pictorial Indicator offers help by reducing attitude-recognition time at the extreme angles often encountered during combat acrobatics and during periods of violent turbulence on instruments.

The first so-called "attitude" gyros did not meet with sufficient pilot enthusiasm to overcome the strong hold that the earlier artificial horizons had on instrument pilots. In many cases, the misinterpretation was greater than the basic change from "seat-of-the-pants" flying to "on-the-gauges".

The new Lear indicator is so quickly readable that even a novice on instruments would recognize immediately his relative attitude with hardly any feeling that he is not in fact visual! It displays the familiar reference airplane against a moving background sphere which is painted to simulate sky, horizon and earth.

The background is free to move a full 360 degrees in roll without obstruction, and can be multiple-rolled without error accumulation. The response servo systems in the indicator can follow both pitch and roll rates up to 180 degrees per second. Thus the most violent attitudes that can be encountered in heavy to extreme instrument turbulence are well within the capabilities of the instrument.

Although designed primarily for combat jet aircraft, the Lear Pictorial VGI Indicator provides more exact attitude indication and easier readability for commercial applications as well. The ability to read quickly and accurately to within 1 degree of climb or dive rather than rule-of-thumb estimating on the part of the pilot, means improved attitude control for GCA and ILS approaches, instrument climb-outs, etc.

Briefing Manuals Available on Omni, DME, RMI

One of the advantages of the American way of life is not just the freedom to criticize a current administration, to go to a ball game instead of the office, etc., but also to be the sole object of affection of all manufacturers of goods designed to ease and improve our way of life.

Thus, for the expenditure of not more than a postcard or a three-cent stamp, any taxpayer member of the flying public who is dissatisfied with government pamphlet descriptions of the latest in airborne radio navigational gadgets, can draw the attention of said manufacturers to his plight and receive an abundance of beautifully illustrated, simply explained brochures on the subject of the workings of said gadgets.

Some of the best to come this way, and certainly easier and more pleasant reading than the above-mentioned government pamphlets, are the latest Collins and Narco Omni, DME and associated flight system brochures. Both companies go to great length to make very simple the whole matter of flying their equipment, and each emphasizes some particular phase that should appeal to many pilots.

As an example, Narco suggests ways of employing their new DME to circumvent the high-density traffic and heavily populated areas that

seem always to lie between the pilot and his destination airport as he approaches the city of his destination, often in low visibility. A word of caution might be in order, however —no novice should interpret their suggested techniques as a safe alternate to the surveyed and approved instrument approach procedures and paths at any such location!

The Collins navigation system brochures illustrate and expound the operation, theory and techniques associated with their Integrated Flight System and off-course "waypoint" computer. Studying and assimilating the advantages of direct IFR navigation from any one point in the range of the associated ground stations to any other point at the pilot's pleasure, is some of the best reading today.

Although many reviews of these items have been published in contemporary publications, they have necessarily been limited in space and scope and could not compare with the enlightening effect of the advertising brochures. For example, in a small, pocket-size pamphlet, Collins describes their airborne Omni equipment and its use, and include therein one of the best and most-easily understood explanations of the RMI (Radio-Magnetic Indicator) that has ever been published. If any reader has any lingering doubts as to the working of these things, even after actual acquisition, we suggest he request copies of these brochures. Write NARCO at 180 S. Main St., Ambler, Pa.; Collins at 855 35th St., N.E., Cedar Rapids, Iowa.

CAA Evaluating New Method of Calibrating Omnirange Stations

A new method by which VHF Omnirange stations can be calibrated without flight tests and put back on the air in approximately 20 minutes following repair or replacement of components is under evaluation by the Civil Aeronautics Administration, U. S. Department of Commerce, Administrator F. B. Lee has announced.

The new procedure was perfected at CAA's Technical Development and Evaluation Center at Indianapolis, where it was tested for six months. It consists of moving a small, lightweight detector around the counterpoise of the VOR and recording the monitor readings at desired intervals and the data plotted to produce a calibration curve. This method of calibration has made it possible to adjust a VOR to much closer tolerances than previously possible. Accuracies of plus or minus 3/4 degree have been achieved without difficulty by use of the new method, thereby reducing the need for an immediate flight check of the facility. At present, CAA Regulations require a flight check by Airways Flight Inspection Patrol pilots before a radio navigational facility is considered operationally safe after a major outage. This often has a considerable effect on both airway operations and traffic control.

A further safety feature of the new procedure is that it makes possible routine and special ground checks of a VOR facility without interrupting omnirange service. To further evaluate the procedure the CAA will test it at 12 existing omniranges located on all types of terrain in various sections of the county. These tests will be for a six-month period.

Twenty-Two LF Ranges Being Decommissioned

Out of 55 LF ranges proposed for decommissioning this year, re-examination by the Air Coordinating Committee revealed that only 22 could be discontinued without obvious serious impairment of the LF airway system. (Proposals to discontinue about 15 more are anticipated and public announcement will be made prior to final decision).

The ranges being decommissioned, and which should be circled as "suspect" on existing aeronautical charts for flight planning purposes (Watch Air-Guide) are:

BARRE-MONTPELIER, Vt.	KIRKSVILLE, Mo.
BURLINGTON, Iowa	LAFAYETTE, Ind.
CAMPBELLTON, Ga.	LAREDO, Tex.
CARLSBAD, N. Mex.	MONROE, La.
COEUR d'ALENE, Idaho	RODEO, N. Mex.
COLORADO SPRINGS, Col.	SALINAS, Cal.
DAYTON, Ohio	ST. JOSEPH, Mo.
DOUGLAS, Ariz.	THERMAL, Cal.
EVANSVILLE, Ind.	WALNUT RIDGE, Ark.
FAIRFIELD, Utah	WATERTOWN, S.D.
JOPLIN, Mo.	WILLMAR, Minn.

Dove Doubts LGA Radar

Initial use of the NARCO DME has produced some slightly confusing situations. Take an incident at La Guardia Field, New York, recently. A. M. Bertolet of Reading Aviation Service, Reading, Pa., installed a NARCO DME in a company deHavilland *Dove* and, while approaching La Guardia, asked La Guardia radar to compare distance indications. As the *Dove* came down the ILS, they found that the DME readings and the radar readings consistently disagreed by about a half mile. After some quibbling over the radio as to who was wrong, the answer suddenly dawned. The discrepancy in their readings was precisely the same distance as that from the La Guardia radar tower to the DME ground unit located in the ILS shack across the airport!

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the avation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

NBAA Backs CAA on VOR-DME Stand

The NBAA fully supports the CAA's decision to proceed with VOR-DME installations in the common system of air navigation. The Association is not in accord with the Air Transport Association's stand that the CAA should delay these installations pending evaluation of the controversal military TACAN system. In a letter addressed to CAA Administrator Fred B. Lee, Cole H. Morrow, Chairman of the Board of Directors of NBAA, stated, "*ATA is the representative of one of the users of the airspace, but is not the representative, and we do not think they should take the liberty of trying to speak for other segments of the industry, particularly when we are not in agreement with their position.*" . . .

Morrow continued, "*We feel there is a definite and urgent operational need at this time for DME . . . we are encouraged that you are going ahead so that we can begin immediately to derive some benefit from the expenditures already made. We recognize that it not possible to transfer funds from one budget item to another, even if it were desirable to do so, and we believe that the operational use of DME will enable many of the traffic control problems to be handled better under the reduced personnel conditions that exist.*"

Radio Control of Airport Lights from Aircraft Studied by RTCA

The Radio Technical Commission for Aeronautics is investigating the feasibility of remote-control operation of field lights at airports which are unattended at night. As a member of the RTCA Executive Committee, NBAA has strongly supported this study.

The operation of airport lights by aircraft radio has been tested in preliminary experiments by one airline which utilizes some smaller airports. A number of problems must be resolved, however, before an effective remote-control lighting system can be established.

In the tests that have been conducted, a radio receiver to which a suitable switching mechanism had been connected was installed at the airport. The approaching pilot turned on the airport lights by pressing the microphone switch of his aircraft transmitter a predetermined number of times. The lights were extinguished by similar action after take-off.

Such a system could become an important safety factor by increasing the number of landing fields available in emergencies.

RTCA Special Committee 56, already established to review the over-all aeronautical communication requirements anticipated during the transition period of the Common System, is evaluating the advantages and problems inherent in the radio-controlled automatic airport lighting system.

VOR Equipment Accuracy Checks are Proposed

An amendment to Part 48 of the Civil Air Regulations which would require VOR equipment accuracy checks is proposed by CAB. The amendment would require inspection of VOR equipment of an aircraft if it is to be operated under instrument flight rules using VOR. The proposed inspection would be required within the preceding 10 hours of aircraft flight time, but not more than 10 days from the previous check regardless of flight time, except for aircraft in which VOR equipment is maintained, checked and inspected according to procedure approved by the Administrator. Bearing errors would be cause of cancellation of IFR flight based on VOR facilities.

Briefly, checks would be made by (1) checking VOR receiving system with approved CAA test signal (allowable error: plus or minus 4°), or (2) if CAA signal is not available, by using points on airport surface designated by Administrator as VOR system check points (allowable error: plus or minus 4°), or (3) if neither of these is available, the following procedure should be followed: select VOR bearing along center of established VOR airway; choose prominent ground fix along this line, preferably more than 20 miles from the VOR ground facility, and maneuver aircraft directly over fix at low altitude; compare VOR bearing with published bearing (plus or minus 6°).

Business pilots wishing to comment on the proposed rule should send their communications in duplicate to CAB, Bureau of safety Regulation, Washington 25.

New Members

The Aro Equipment Corp., Bryan, Ohio.
NBAA Rep.—M. J. Anderson, Asst to *Pres.*
Chief Pilot—Clay M. Spear
In charge of aviation activities—M. J. Anderson
Nature of business—Manufacturer of air tools, lubrication equipment and aircraft products
Company operates—Beech D18S and Cessna 180
Based at—Bryan-Defiance Airport

Associated Radio Co., Dallas Texas
NBAA Rep.—Anthony E. Aguilar, Pres.
Nature of business—aircraft radio and electronic equipment

Collins Stores, Charlotte, N. C.
NBAA Rep.—Wm. A. Collins, Pres.
Chief Pilot—Wendell H. Karr
In charge of aviation activities—Wm. A. Collins
Nature of business—Chain Department Stores
Company operates—*Bonanza,* Cessna 170
Based at—Myrtle Beach, S. C.

Dairypak, Inc., Cleveland, Ohio
NBAA Rep.—Philip Van Treuren
Chief Pilot—P. Van Treuren
In charge of aviation activities—P. Van Treuren
Nature of business—Manufacturer of paper milk cartons
Company operates—two D18S' based at Cleveland; one Piper *Tri-Pacer* based at Clinton, Iowa

J. R. Gray Co., Inc., Dallas, Texas
NBAA Rep.—J. R. Gray, Pres.
Chief Pilot—J. T. Hutchins
In charge of aviation activities—J. R. Gray
Nature of business—aircraft sales and service (Beech distributor)
Company operates—*Bonanza* and D18S
Based at—Love Field, Dallas

Gulf Oil Corp., Pittsburgh, Pa.
NBAA Rep.—John Rowan
In charge of aviation activities—John Rowan
Nature of business—Petroleum products
Company operates—D18S, DC-3, two Lockheed L-18's

National Aeronautical Corp., Ambler, Pa.
NBAA Rep.—G. F. Quinby, Sales Mgr.
Chief Pilot—Gil Quinby
In charge of aviation activities—James Riddle, Pres.
Nature of business—airborne electronics equipment, receivers, transceivers, Omni and DME
Company operates—*Bonanza*
Based at—Wings Field, Ambler

Insurance Co. of North America, Philadelphia
NBAA Rep.—James H. Chenet, Asst. Secy.
Nature of business—Insurance

Cockpit PITFALLS

from the Files of the Flight Safety Foundation

by Jerome Lederer and Robert Osborn

WATCH THOSE SPECKS

The captain of an executive B-23 was surprised to find that a new speck on his windshield was equipped with four powerplants. The speck, a DC-6, was descending under VFR conditions at a speed estimated to be over 500 mph. The B-23 was flying straight and level at 240 mph. The B-23 pilot estimated that from the time he recognized that he and the DC-6 were on a collision course to the time that he passed about 50 feet under the wing of the DC-6 was less than six seconds. Of this, three seconds were spent in evaluating the situation, leaving about three seconds for evasive action.

He observed that at a distance of about a mile, the head-on appearance of a modern-type airplane is very similar to a speck on the windshield.

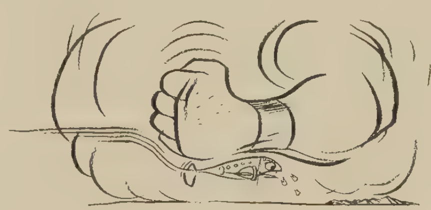
There were three crewmen in the cockpit of the DC-6; he and his copilot in the cockpit of the B-23. The copilot of the B-23 never did see the DC-6. None of the three crewmen in the DC-6 saw the B-23 at any time!

Five crewmen in the cockpits of these two planes; only one saw the imminence of collision!

HOW LOW CAN YOU GET?

The Flight was in contact with Control Tower. The Tower gave the official weather with the advice that a thunderstorm was located approximately 15 miles west, but the airport was wide open. At 1415C the pilot of an Air Force weather reconnaissance flight observed the Flight as it

disappeared into the thunderstorm at approximately 2500 feet. The Flight crashed in a wooded area. Observations of the Air Force pilot and the witnesses indicate the storm was severe with heavy rain. As observed from the west side of the storm toward which the flight was proceeding, there was nothing to indicate its severe intensity.



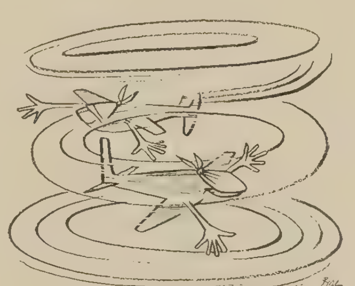
"Don't get yourself outclassed."

Examination of the aircraft, powerplant and their respective components disclosed no evidence of structural failure, malfunction, fire or lightning strike prior to impact. The aircraft struck the ground at a fairly flat angle. Both engines were apparently under full power.

It would appear that the pilot should have detoured around this storm rather than attempt to go through it at such a low altitude. It is questionable practice to fly through any thunderstorm.

LISTEN AND LIVE

In the New York area, there was the usual stack-up during a busy period of the late afternoon during instrument weather. Flight "A" was at 4500 feet and Flight "B" at 3500 feet. Flight "B" was told to descend to 2500 feet, but due to a misunderstood message it remained at 3500 feet. Flight "A" in the meantime was told to descend to 3500 feet as this altitude was thought to be clear of any aircraft.



Both flights were in the same holding pattern and at the same altitude for *approximately 19 minutes,* on instruments, in turbulence. Object lesson: Be sure of your ATC instructions and be sure that the ATC Controller knows your intentions.

DON'T RELY ON BRAKES

The flight made a straight-in instrument approach and established visual ground contact just prior to reaching the middle marker. The aircraft touched down approximately one-half way down the runway and brakes were applied with no noticeable effect. The aircraft ran through the boundary fence and crossed a highway, coming to rest in an upright position. All of the occupants evacuated through the main cabin door.

Three crew—no injuries; 17 passengers—no injuries.

FLIGHT PLANNING

In proper flight planning there are a few basic rules that should be followed. Below are listed some of them:

Check the NOTAMS for your entire route and areas adjacent to your destination and its alternate.

Make a thorough check of the weather:

a. Teletype reports and forecasts
b. Previous sequences
c. Adiabatic charts
d. Area, route and terminal forecasts
e. Pilots' reports

Select an altitude where your aircraft will operate most efficiently and receive the most benefit from upper winds. Use the 700 milibar and wind aloft charts.

Check the special notices to airmen on the back of the Radio Facility chart.

Thoroughly check weight and balance.

Ascertain that all equipment, such as radios, anti- and de-icing, survival, oxygen, etc. is adequate for the flight.

Compare the total distance and terrain of the route against the range and ceiling of your aircraft.

Prepare the flight progress chart prior to your departure.

Check your aircraft for current Pilot's Handbooks and ILS book.

Brief your passengers on emergency bail-out, ditching and crash landing signals and procedures.

Brief the First Officer on duties and procedures during take-off.

Carry a flashlight.

Stay on the alert and brief your crew to stay on the alert and maintain a constant and vigilant watch for other aircraft in flight to avoid mid-air collisions.

Skyways Round Table

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Martin 404 would be a bit too big.

"We had high hopes of working out something with Canadair on the L-42, but the last word I had from them was that they had given up on the project because of the requirements of the CAA.

"Cities Service would like something that would carry 10 to 12 passengers, would cruise at 300 mph and have a 3,000-mile cruising range. All our top executives keep asking, 'How far will it go before you have to land?' The lesser executives want a plane suitable for short hops and they don't require pressurization at the present time. However, if the top executives get it, it won't be long before the other executives will start to holler for it, too.

"Right now I don't see anything in this Convair 340. As you say, there are some available for $675,000 each, but by the time you put in your interior and the radio you need, you'd have pretty close to a million dollars in one airplane. That's a lot."

Wm. Person: *"It is, George, but we have to set our sights on something that's available today. If we're going to become involved in the engineering costs that would be necessary in the development of a business plane, that will be tremendous, too. It would be pretty difficult to build an airplane that would give the utmost in performance and the range required, and keep it at a reasonable figure. The 3,000 miles and 300 mph is slightly beyond the DC-6 and the Connie set-up at the moment."*

Steve Brown: "Actually a 240 or a 340 carries around 10,000 lbs of fuel and 14 or 15 passengers. The gasoline capacity on a converted 240 is 1550 gallons, and 1730 gallons on a 340. There's about an 8-mph difference in the two airplanes with the same horsepower, so your range is practically the same."

William R. Strong *(Chief Pilot, National Dairy Products Co., Inc.)*:

"Everyone realizes that in order to get the speed and the range to be legal with 15 passengers, we're going to have to have something about the size of the Convair. I also agree that you're going to have to have another type airplane, maybe a Twin Beech or a *Lodestar* or a DC-3. In our operation, there are a lot of places you can't operate a 240 or a 340. The airports aren't always large enough and it wouldn't be feasible, economically, to use the airplane on a trip where you're out 17 days and make two stops every day. Therefore, I think we're going to have to go back to a DC-3 or perhaps a more modern type such as the de Havilland *Heron*."

Owen Mayfield *(Chief Pilot, Hercules Powder Co.)*: "Rip has a good point. We can't all use the Convair 240 in a lot of our work. Perhaps we could use it a half a dozen times a year for coast-to-coast trips, but most of our trips are shorter than that and we don't need the passenger capacity of the 240. We'd like to hold our costs down below what it costs to operate a 240 or to even buy a 240. A smaller airplane would suit us better. Since the old DC-3 has been given an increase in its gross weight, I wonder if a pressurization program on a DC-3 might not give us some of the answers we want. Perhaps a DC-3 could be pressurized and R-2000's installed. I'd say pressurization would add somewhere around 800 pounds to the -3, and you'd burn a little more fuel with R-2000's.

"From my conversations with engineers, I'd judge that pressurizing a DC-3 is entirely feasible. It could be done by using a circular section insert inside the present fuselage. There undoubtedly would be a lot of problems to work out and it would be fairly expensive to engineer the first one. But there are a lot of DC-3's used by companies, and if the cost could be shared it would be feasible."

Wm. Person: *"Owen, in an earlier statement I believe you said you'd want an airplane that would operate shorter hauls than the Convair. I believe American Airlines' average mileage between stops is something like 200 miles."*

Owen Mayfield: "That's true, but you were speaking of extra tanks in the Convair, and I don't think we need that much airplane. As far as speed is concerned, it would be desirable to go coast-to-coast in one day, but whether you travel at DC-6 speed or it takes 10 hours is unimportant just so long as you can make the trip in one day.

"A 300-mph airplane isn't essential in our type of operation. But we would like an airplane that would fit a 3,000-ft runway and that would true out somewhere around 220 or 230 mph."

Wm. Person: *"A serious problem exists today in Lodestar/DC-3 operations. How do you carry the six passengers you want to carry and put in 800 gallons of gasoline? There are very few -3's that you can legally fly at that weight. In fact, this is true of aircraft other than the DC-3."*

Owen Mayfield: "Actually, Bill, if the empty weight of the DC-3 is kept down, you can do a lot better than that. We carry 10 passengers, have the four wing tanks full, and we don't exceed 25,200 pounds."

George Pomeroy: "The gross now is 26,200."

Owen Mayfield: "That's right. Now you can go up to 26,200 or even 26,900 if you go into a lot of modification, rudder tabs, etc. Our empty weight is 18,000 pounds."

Rip Strong: "The empty weight of our -3 runs 19,001, and I have the same extra tank that George Pomeroy has in his airplane. I figure I can carry the maximum gas load, five to six passengers with baggage, etc., and be legal. What additional equipment do you have on a -3 to get the 26,200?"

Mel Rummel *(Mgr., Maintenance Engr., Flight Safety, Inc.)*: "The basic requirements for 26,200 lbs take-off gross weight are airplane performance, which is predicated on horsepower allowed, and a CAA-Approved Airplane Flight Manual. Take-off horsepower to meet the performance requirements must be 1200 or better. The C-47 type landing gear allows you to increase your maximum landing gross weight to 26,000 lbs. With DC-3 gear the maximum landing gross weight remains at 25,200 lbs. Using 1350 hp for take-off requires the geared rudder trim tab. Flight Safety, Inc. now has CAA-Approved Airplane Flight Manuals available for the various engine and landing gear installations.

"The increase to take-off gross weight of 26,900 lbs requires 1350 hp for take-off. Certain flight test work and some engineering are required for the preparation of the manual to cover this take-off weight."

George Pomeroy: "Do you have any information on the T-36?"

Steve Brown: "The airplane was built as a training plane for transition into jets. The stall speed is 110 mph, and I don't think that, with a wing loading of 58 lbs per square foot on a twin-engine airplane, you want an airplane that is going to stall at 110 mph. You have to make your average landing at 120 or more. Also, the engine they planned to use on the T-36 was the CB-3, and it has no high blower. If we are going into pressurization, we'd have to have high-blower operation in order to get the cruise altitude and single-engine performance you need over the Rockies.

"A Convair 240 stalls at around 86 mph at gross weight, and it has a wing loading of about 46 pounds. In my opinion this makes more sense than a T-36 or L-42 when you're flying the airplane on approaches.

"Getting back to the R-2000 on the DC-3, I've checked into that. I worked with Ed Hudlow and John Chamberlain in Washington and they intimated that we would have a big problem in trying to get an extra 3,000 pounds on our Martin which is an NL airplane. They led me to believe that on upping these gross weights, they are going to make you go out and pass T-Category. The DC-3 just won't do it.

"You have to draw the line somewhere. You can't keep re-working and modifying the trim tab on the aileron for the DC-3, or the rudder trim tab, and then put on R-2000's and keep upping the gross weight."

Wm. Person: *"Mel, how about the possibility of pressurization for the DC-3 or* Lodestar?"

Mel Rummel: "Of course, the DC-3 was never designed for pressurization. To pressurize an aircraft not originally designed for it means practically rebuilding that airplane. Owen Mayfield's suggestion of putting a shell inside the fuselage is about the only approach you can make, but it would cost a lot.

"We are investigating the possibility of pressurizing the B-23 and one of the problems facing us is the means for driving the super-charger. The B-23's are presently equipped with WAC-2600 engines, and the only drive available that can handle an engine-driven supercharger is the generator drive. Utilizing this drive on the B-23 would mean operating with just one generator which would not be practical. One solution would be to install 2800 engines where you have the dual generator pad available. However, this in itself would require quite a bit of work. Another solution would be hydraulically driven units. These require about 10 hp and the pads available on the 2600 are not that high.

"Putting R-2000's on a DC-3 is not the answer to pressurizing the airplane. Assuming you were to use the same type pressurization equipment now installed on the Convair, the output of which should meet the requirements of a DC-3 fuselage, you will still have the problem of a power supply for driving the superchargers. I don't believe the R-2000 could handle hydraulically driven units and there isn't a pad available for an engine-driven unit. Some operators of the 240's have gone to the engine-driven Stratos supercharger.

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To use pressurization units presently available would appear to require at least the 2800 engine."

Harold Terrington *(Acting Asst. Chief Pilot, Union Carbide & Carbon Corp)*: "We were looking for some faster equipment, so we purchased the Convair. We also have two of the Chicago & Southern DC-3's which are good. They are quite light, and we're installing the heavy-truss gear, with 1820-72A engines. We'll true out at about 205 mph with only 675 hp . . . . 1350 for take-off. That's including full Collins, an A-12, all the bulletins complied with, one-piece windshield, etc. We can carry eight passengers with all their gear, a crew of two, and still be just a little over 25,300 gross take-off weight. That gives good single-engine performance and an airplane that's comparable to an 1830-75 *Lodestar* but with a better cruising range. Personally, I feel a fast DC-3 is the best airplane in the business for short-field and low-cost operations."

Wm. Person: *"Clint Bacastow, you might explain your set-up."*

C. F. Bacastow *(Vice Pres., Aircraft Service, Inc.)*: "We are a subsidiary of the F. C. Russell Company. In trying to lick this problem of economy in operation where overhead represents at least 60% of cost, the F. C. Russell Co. set up a subsidiary whereby we offer the services of our aircraft to other companies in order to get increased utilization and, therefore, cut down on the operating cost. In conjunction with that, we have a general fixed-base operation which services our own aircraft as well as those of other companies in the area. At the end of our first year of operation, it definitely proved itself to be an advantageous method. We have increased the use of our aircraft and we have spread the overhead, thus reducing costs.

"The emphasis in our operation is not so much on range. Our average trips are in the 500- to 800-mile category, and speed is not as important a factor as it would be on longer trips. What we are looking for is flexibility. The DC-3 is ideal for us, and we don't feel there is any other aircraft in sight that will improve our operation."

Steve Brown: "When we bought our B-24 some five years ago, there was a lot of criticism, not from within our own company but from those on the outside. Today, almost everyone thinks we made a smart move, and I think we did. The B-24 has served us well. It was inexpensive at the time, and today it costs us only about $30 an hour more to operate than the *Lodestar*. The *Lodestar* runs $190 an hour, and the B-24, $220. We don't have pressurization, but we do have the range, and we can average 225 mph at 625 hp. In other words, we start out with 3200 gallons of gas and a load of passengers and for the first three hours we might draw 675 hp to fly 225 mph. But when we're down to a thousand gallons, we draw 575 hp and still get 225 mph. Therefore, we figure an average of 625 hp for 225 mph. That's with a 16-hour range and you can go a long way in that time.

"As far as range is concerned with the Convair, if the people don't need the range, we don't have to talk about extra tanks in the 240. You can just sit there with a thousand gallons and have five hours of range with roughly 1150 hp per engine. You don't have to spend that extra $60,000 for another 550 gallons of gas. You can run it with the present CA-15 engines or the CA-18's and you'd have all the safety you could get if you installed CB-16's and went in for the additional 550 gallons."

Owen Mayfield: "Going back to pressurizing the -3, what about the

possibility of running a pressurization unit from one of the larger 1820 Wright engines?'

Steve Brown: "You have to have a dual pad. You can either run a pressurization system off the second pad or you can run an AC generator, and to my knowledge there's nothing below an R-2800 engine that is equipped for this work load."

Wm. Person: *"Today, if a company uses an airplane 600 or 700 hours a year, we think that's good utilization. Why couldn't a company operating six aircraft fly those airplanes 1,000 or 1200 hours apiece?"*

George Pomeroy: "We have considered that. We figured on streamlining our equipment, reducing the number of units and pushing the faster equipment through rotation of crews, the same as the airlines do. Instead of operating 400 or 500 hours a year, we could probably go to 700 or 800. However, you have to realize that you're going from a 200-mph airplane to a 300-mph one, and you're going to cover a lot more territory in an hour than you did before. By streamlining your organization, I think you could use a fast airplane a lot more effectively and economically by just turning it loose and letting it run."

C. F. Bacastow: "In our operation, we feel that we should use the airplane that is best suited for the particular type of flight that we want to make. Therefore, we have four types of aircraft: the Cessna 170 for trips up to 100 or 150 miles; a *Bonanza*; a Twin Beech which is ideal for four executives traveling within a 500-mile radius; and a DC-3 which provides maximum comfort for longer trips. With that fleet, we have achieved considerable flexibility."

Harold Terrington: "I think it's fine to make modifications in DC-3's *Lodestars*, PV's and A or B-26's, but when you get into such a complex business as pressurization, I think you're wasting your time because of the amount of money involved.

"The Convair and Martin are pressurized, that's true, but with them you have the problem of maintenance. A very complete line of spare parts must be aboard at all times, and many fields that executive operators go into cannot handle maintenance for Martins and Convairs. In view of the fact that we give our bosses schedules to meet their needs, and personalized service, we're a lot better off flying a little lower and slower and just as safe because we have proven airplanes. I think they've done all they can do with the DC-3, and I'm inclined to stick with it until something specifically for executive travel is available."

Wm. Person: *"George and Steve, you both operate DC-3's and* Lodestars *and you also operate faster airplanes. What are your opinions?"*

George Pomeroy: "The high echelon requires the speed. My boss thinks nothing of calling me up at 11 o'clock in the morning and reporting that he has to be in Denver by 9 o'clock that night. The only aircraft we have that can do that trip without stopping is an A-26."

Steve Brown: "I agree with George. Speed may not be the essence for all the pilots, but it is for the passengers. I'd like to see all of us get something that gives all the comforts and that can compare, speed-wise, with the DC-7's. Portal to portal, the equipment we are using today can beat the airlines over distances of 1500 miles, but we're talking now about 3,000 miles. Speed is a big factor and we definitely need something that will compare with scheduled air transportation coast to coast.

Owen Mayfield: "The bosses do want speed, but at the same time

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they have to have an airplane that can land at some small airport where the runways are only 2800 ft long. They want speed, but they don't always realize that to get much utility out of an airplane, it has to be able to land at reasonably small airports."

Wm. Person: *"Steve, weren't you the one who reported your executives would rather go in a faster airplane and then ride 40 or 50 miles in a car than go in a slower plane that might be able to get into a smaller airport nearer their destination?"*

Steve Brown: "That's right. Our company has a number of plants throughout this country and Canada, and most of them are not far from what we'd consider smaller airports. About six months out of a year, we have to pass them up—even with the slowest equipment as far as landing speed is concerned. Either it's the spring thaw, rain, or what-have-you. We've found that even if an airport manager reports his field is in good condition and that DC-3's, Beechcrafts, etc., go in there all the time, you take a look at the place and maybe do land once, but that's all. You and your passengers just don't want to go in again. We have a limitation of 2500 ft minimum on our light wing loaded equipment, providing there are no obstructions. As time goes on, you are going to eliminate more and more of those grass fields and go into larger airports that may not be as close to your destination but are safer all around."

Harold Terrington: "What utilization are you getting on your Martin?"

Steve Brown: "Considering the length of time we've had it, we're doing very well. For the past two years, our highest utilization has been on the B-24, the very airplane that we were criticized for getting. Our people like the B-24's range and they think its speed is comparable to other equipment."

Wm. Person: *"How many hours a year do you average?"*

Steve Brown: "Last year the B-24 averaged 65 hours a month; our lowest average was 58 hours, 45 minutes with the Beech. I'd say we have averaged close to 60 hours per month per airplane for years.

"Actually, we cannot build up any more utilization on our airplanes because you can't keep crews proficient on four different makes. We try to keep two people checked out on each airplane; two on the B-24, two on the *Lodestar*, etc., with everyone checked out on the Twin Beech. In my opinion anyone that flies an airplane less than 15 hours a month can't keep up his proficiency. That's the basis of the program I am getting ready to present to my company. I'd like to see some standardization where you and I are operating aircraft with similar engines, the same kind of pressurization, generators, etc., so that we can pool our resources and come up with something that will give comfort, reasonably good range and speed."

Rip Strong: "Getting into the economics of a larger airplane, it seems to me that the executives of these collective corporations could swing a deal with the Department of Defense where, if there were 200 Convairs owned and operated by the corporations and flown by experienced crews, they'd have 200 airplanes the Department of Defense could take over in case of an emergency. Perhaps the Department of Defense would subsidize some part of the purchase of these airplanes."

Owen Mayfield: "Wouldn't it be feasible for NBAA to work with the Air Force to see if an airplane couldn't be designed and built for the Air Force that the business-plane operators could use?

Steve Brown: "North American's Sales Department attempted to interest Washington, through the Navy, the Air Force, and the Army, in a personnel transport. But the Government merely answered that it already had cancelled the T-36 project which would have fulfilled its needs.

"The management of North American indicated they would be interested in going ahead with its business-plane design if they could get some help with the engineering cost. Last spring, North American estimated it would cost $21,000,000 to develop the aircraft, with two prototypes."

Wm. Person: *"With general economies as they are today, particularly in Washington, it would be pretty hard to convince the Air Force it should subsidize corporate business fleets to any degree. The CAA is having trouble getting sufficient funds to operate necessary facilities.*

"At the beginning of this meeting I tossed out some figures of $500 and $600 per hour as the cost of operating a Convair, including everything. If we took DC-3 operations as an average and took the identical costs that have been projected here, I wonder if we wouldn't find that our DC-3 costs are higher than we think."

George Pomeroy: "It's all according to what you have the aircraft on the books for, and how many hours per month you fly. When you first

get a DC-3 on the books, it probably costs $180 an hour. But after you've written it off down to where it's in the salvage bracket, it's probably $90."

Mr. Person: *"Mel, have you anything on this Pan American 240 deal that would be of interest here?"*

Mel Rummel: "Dick Adams, who manages Pan Am's Brownsville customer base, planned to be here, but at the last minute couldn't make it. He phoned me this morning, however, and gave me some rough figures on the 240.

"Pan Am's basic 240 airplanes are available at $300,000 each. He also has some zero-time 340's with an airline interior that can be had for $625,000 each. The proposed executive CV-240's will have CB-16 engines and 23E60 propellers with either the 2H17AA or the 2H17 new blade. Take-off weight, with automatic feathering, is 42,500 pounds; that's with maximum fuel of 1,000 gallons. They all have Stratos pressurization systems. If the customer wants an air-stair door, there is a kit available that costs about $15,000, installing it costs another $12,000. Putting in the long-range outer wing tanks will cost $47,000. A Convair 240 with an executive interior, an air-stair door, long-range tanks, etc., will come to somewhere between $400,000 and $425,000. Cruising at 10,000 ft. the 240 trues out at 267 mph.

"As far as spares are concerned, a propeller would be $11,000; a complete power package would be $47,000, a bare engine $35,000; accessories, instruments, etc. would run you about $30,000; and if you wanted a spare supercharger, it would cost another $7,000. Roughly speaking, a Convair 240, complete with spare engine, spare power pack and parts, comes to about $500,000."

Wm. Person: *"Gentlemen, I think we've covered this situation quite thoroughly. Undoubtedly, as more and more companies go into Convairs and Martins and are successful with them, the word will get around, and then even more companies will begin using them. In short, I think you'll soon see a lot of successful Convair operations. This, despite the fact that conversion here indicates a divided opinion as to the feasibility of using the newer transports for executive or business flying. With these newer types costing in the vicinity of $650,000, economics play a most important part in the problem. Not only would there be additions to the direct operating costs (gas, oil, salaries, hangar rent, etc.) but there would be additions to the*

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. . . Flare-Out Control

(Continued from Page 15)

Height information from the altimeter will then be furnished to a so-called flare-out computer. If the aircraft is not following the correct exponential path, the flare-out computer will send an error signal to the pitch channel of the automatic approach coupler which will, in turn, cause the automatic pilot to change the pitch attitude of the aircraft. This new pitch attitude will cause the aircraft to assume a new rate of descent, tending to correct the error from the desired exponential path.

This rudimentary automatic flare-out system is shown in block diagram form in *Figure 2.*

Inadequacy of Basic System

As with any closed-loop dynamic system of this type, the over-all tightness of control is limited by stability considerations. If the system of *Figure 2* is simulated on an analog computer, it will be found that the damping of the system becomes progressively worse as the gain of the flare-out computer is increased. (By flare-out computer gain, we mean the number of volts error signal sent to the approach coupler for a given magnitude of path error.)

There will be a certain gain setting at which the entire system will sustain itself in oscillation indefinitely. At any greater gain setting, the oscillations will diverge and the system is dynamically unstable.

The critical flare-out computer gain setting required for the sustained oscillation may be determined by the following method:

A sinusoidal error voltage is applied to the automatic approach coupler with the flare-out computer disconnected. For each frequency of this input signal, the aircraft will respond with a sinusoidal height oscillation. The magnitude of the height oscillation and its phase angle relative to the input error signal will be functions of the frequency of oscillation of the input.

A plot of the magnitude of the height oscillation for a unit error oscillation and the phase angle by which the height oscillation lags the input signal is shown in *Figure 3.* These data were obtained by the use of an analog computer which simulated the dynamic behavior of a T-33 aircraft in the landing configuration at 140 mph. An actual Lear F-5 automatic pilot and automatic approach coupler were used in conjunction with the simulated aircraft.

An idealized automatic flare-out computer is governed by the following equation:

$$A(h + Kh) = \textit{error signal}$$

In operational notation, this is expressed as the transfer function,

$$\frac{\textit{error signal}}{h} = A\,(1 + K\rho) \qquad (3)$$

The frequency response of an idealized first order flare-out computer was determined analytically, using equation (3). This is shown in *Figure 4* for A = 1°.

Assume now that a sinusoidal error oscillation enters the approach coupler-automatic pilot-airplane combination. The height response of the airplane will be sinusoidal and will lag the input error signal by a degrees as given by *Figure 3* for the frequency in question. With the loop closed, this height oscillation will be fed back through the flare-out computer as a new error signal. This new error signal will lead the height oscillation by B degrees as given by *Figure 4* for the same frequency.

If the frequency of the original error signal is such that $a = B$, it is apparent that the phase lead of the flare-out computer will nullify the phase lag of the approach coupler-automatic pilot-airplane combination. As a result, the new error signal will be exactly in phase with the original signal. In addition, if the gain of the flare-out computer at this frequency is such that the amplitude of the new error signal is exactly the same as the original, the system will maintain itself in oscillation indefinitely. If the gain is reduced, the oscillations will die out; while if the gain is increased, each succeeding error signal will be larger and the system dynamically unstable.

It should be noted that the original error signal need not be sinusoidal in order to start the oscillations. In fact it can be shown, through the use of the Fourier integral, that any transient disturbance to the system can be considered to be composed of an infinite series of sinusoidal oscillations of various frequencies.

The determination of the critical frequency and gain setting is more easily accomplished if the information presented in *Figures 3* and *4* is replotted on one piece of paper. This has been done in *Figure 5.* Here, the reciprocal of the amplitude ratio of *Figure 3 is* plotted. The numerical values of this quantity $\frac{\textit{degrees pitch comm.}}{\textit{foot}}$ represents the number of degrees-error signal required at each frequency to produce a one foot height oscillation from the approach coupler-automatic pilot-airplane combination.

The frequency at which the two phase curves cross determines the critical frequency of the system, since here the lead of the flare-out computer equals the lag of the rest of the system. This occurs at .525 cycles per second.

Notice that at this frequency, an error oscillation of 4° is required to produce a unit height oscillation from the aircraft. From the amplitude characteristics of the ideal first order flare-out computer, however, we can see that a unit height oscillation from the aircraft produces a 14.2° error oscillation from the computer if $A = 1$. This means that the system would be dynamically unstable under these conditions, and the static gain of the flare-out computer, A must be reduced to some value below .282° per foot if the system is to be stable.

In actual practice, the gain would necessarily be set much lower since oscillations due to disturbances must be well damped and not sustained. The gain settings will then be far too small for satisfactory performance. This conclusion is a result of the following considerations:

The aircraft is assumed to enter the flare at a glide path angle of 2.5°. If the aircraft is to fly level among the asymptote of its flared path, then its pitch attitude must increase at least 2.5°, and more if the airspeed is decreased. In order to maintain this increased pitch attitude, though, it is necessary that a 2.5° error signal be present to prevent the automatic pilot from decreasing the pitch attitude to its initial value. With a flare-out computer gain setting below .282° per foot, this means that the aircraft could only fly level at least nine feet below the desired asymptote. The system, as it stands, is therefore very unsatisfactory from the standpoint of tight control.

The basic automatic flare-out system described depends entirely on the existence of a displacement from the desired path for control action. It follows that the aircraft can never fly the correct path with this system because a more positive control action is required to flare.

This deficiency is particularly noted at the beginning of the exponential path, because at that time the curvature of the flight path should be a maximum. The system will not begin to move the elevator surfaces until an error exists; as a result, the aircraft will contact the runway before the rate of descent has been significantly reduced.

In addition to the serious short-

comings we have already mentioned, another bad feature of the basic flare-out system is that it attempts to control both rate of descent and pitch attitude by elevator motion alone.

If we are considering only very short time intervals, the elevator can be considered to be the airplane's rate of descent control. We must realize, however, that once the transient response to an elevator motion has subsided, the rate of descent will depend only on engine power, since the engine is the airplane's primary rate of descent control. The rate at which the aircraft is using energy depends upon its drag, speed, and rate of climb, since the latter represents the rate at which the potential energy of the aircraft is increasing or decreasing. This required power can only come from the engine; control of rate of descent by elevator motion alone must be considered to be incomplete and unsatisfactory.

Increasing Tightness of Control

If the tightness of control of the basic idealized automatic flare-out system is to be improved, we must modify the frequency response characteristics of either the flare-out computer or the approach coupler-automatic pilot-airplane combination.

The characteristics of the airplane are, of course, unalterable; and presumably the approach coupler and automatic pilot have been carefully adjusted for optimum performance. We will restrict ourselves then to the mention of three means of increasing the tightness of control. All of these require modifications to the flare-out computer alone.

1. Choice of an optimum smoothing time constant for the flare-out computer.

   The idealized first order flare-out computer has the transfer function, from equation (3):

$$\frac{\textit{error signal}}{h} = A\ (1 + 4p)$$

   If this transfer function is altered to be:

$$\frac{\textit{error signal}}{h} = A\left(\frac{1 + 4p}{1 + \tau p}\right)$$

   then τ is called the smoothing time constant. The existence of some finite value of the smoothing time constant is inevitable in any actual RC differentiating network.

   The function of the smoothing time constant is to reduce the phase lead and the amplitude response of the flare-out computer at the higher frequencies.

   The maximum value of τ is limited by the fact that as τ approaches four seconds, the error signal from the flare-out computer approaches a value proportional to height. The computer then ceases to be a flare-out computer and becomes an altitude control tending to fly the airplane at zero height.

2. Use of a notch network on output of the flare-out computer.

   The notch network is an RC network which theoretically eliminates or greatly attenuates only a very narrow band of input frequencies. An investigation is planned in the use of such a circuit to eliminate the response of the computer to the critical frequency of oscillation.

3. The addition of a voltage proportional to pitch rate to the derived rate of descent in the flare-out computer.

In connection with an analog computer investigation of automatic flare-out control for a C-54 aircraft equipped with an E-4 automatic pilot and approach coupler, it was felt that an improvement in the damping

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. . . Flare-Out Control

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of the system could be obtained by placing the antenna of the altimeter forward of the cg of the aircraft. The reasoning was that the pitch rate of the aircraft would add a linear velocity to the actual rate of descent. Since the pitching rate has considerable phase lead over the rate of descent, an improvement in the phase lag of the open loop response could be expected from an intuitive standpoint.

It was found that the original reasoning on which this idea was based is fallacious for forward distances of less than 60 feet and for frequencies above .30 cycles per second. That is to say, the phase lag at a given frequency is actually greater in this region of the variables. The performance of the system was nevertheless greatly improved, the main benefit being an attenuation of the apparent rate of descent as the frequency is increased. It was also found that the distances forward of the cg that were available even in a large aircraft restricted the tremendous benefits theoretically obtainable with such a scheme.

The present plan is to fool the altimeter into thinking it is located at a greater distance forward of the cg by adding a voltage proportional to pitching rate (this is available from the automatic pilot) to the derived rate of descent signal in the flare-out computer.

Solution for Steady Error

A scrutiny of the automatic flare-out system we have discussed so far has revealed that the flare-out computer gain would have to be infinite to fly the prescribed path without an error. This is because the automatic pilot (which is assumed to be of the displacement type) is trimmed at the beginning of the flare, for a nose-down pitch attitude. Over a short time interval, it will return to this attitude unless there is an error voltage existing from the flare-out computer which tells it to do otherwise. The resulting error displacement from the desired path will decrease if the gain of the computer is increased, but we have seen that the gain is limited for stability reasons.

A practical solution to this steady error problem, which has been tried successfully, is the use of a pitch reference signal. This signal is zero at the beginning of the flare and increases linearly as height decreases. The signal is developed in the flare-out computer and re-trims the automatic pilot as flared path is followed.

It can be shown that for equilibrium conditions,

$$\theta = \frac{\dot{h}}{U} + \frac{2W}{Cla \rho U^2 S}$$

Assuming that the desired rate of descent at touchdown is fixed at some low value, the equilibrium value of pitch angle will increase as the airspeed is reduced. The correct value of the pitch reference signal at zero height is then a function of aircraft weight and landing speed.

Automatic Airspeed Control

In accordance with our previous statements regarding the incomplete rate-of-descent control of the basic flare-out system, analog-computer results have shown that if the T-33 aircraft attempts to fly an exponential path, with a time constant of four seconds, at an initial airspeed of only 120 mph, it will diverge downward from the path and mush into the ground if the throttle setting remains constant. This is, of course, a consequence of the fact that the aircraft is operating on the low side of the power-required vs. airspeed curve. Any decrease in speed requires additional thrust to maintain equilibrium conditions.

It is possible to start the approach faster and successfully follow the correct path even if the thrust is returned to idle during the flare, but an automatic flare-out system which does not control engine power puts the airplane in somewhat the same category as a freely falling body; the aircraft is never in equilibrium and will eventually stall if it is delayed in contacting the ground for a sufficient length of time.

The best automatic flare-out system will then incorporate a control to adjust engine power so that the aircraft can fly the correct path more safely and at several different approach speeds. Such an engine control is referred to as an automatic airspeed control since it manipulates the throttle to maintain a predetermined airspeed as the aircraft is maneuvered. This predetermined airspeed command may be varied with time as the flare-out progresses so the aircraft will touch down at the correct airspeed for the prescribed rate of descent and pitch attitude.

Overcoming Crosswind Effects

The method of making a landing approach in the presence of a crosswind used by all automatic approach systems of which the author has knowledge is that which utilizes a crab angle relative to the true path over the ground.

Unless the aircraft is equipped with castering landing gear, it is necessary that a command be introduced into the yaw chanel of the automatic pilot an instant before touching down to "kick out" this crab angle. This must not be done too soon, or the aircraft will develop an appreciable cross-runway ground velocity before touching down.

An analog computer study was made to determine the best time, before touchdown, to introduce the runway heading command for the T-33 aircraft. It was found that if the commanded heading change is made equal to twice the actual crab angle, the crab will be removed in two seconds and will remain substantially zero for four additional seconds before going the other way. At the end of this six-second period, the sideways velocity with respect to the runway is only .7 ft/sec. per degree of initial crab angle. This means that in general the time at which the command is introduced need not be exact.

The Complete System

A block diagram of a complete automatic flare-out system is shown in *Figure 6*. This system begins with the basic flare-out system (altimeter—computer—approach coupler—automatic pilot—airplane) and may incorporate one or all three of the stabilizing control devices we have mentioned (smoothing time constant, notch network, and pitch rate signal).

In addition, a pitch reference voltage is utilized to eliminate the steady displacement error and to provide a more positive type of control.

An automatic airspeed control provides the needed changes in engine power to fly the required path safely, and an automatic runway heading control is available to remove any crab angle resulting from a cross wind. On the basis of our simulator studies, we have concluded that a fully successful automatic flare-out system must incorporate these essential items.

Flight Tests of Equipment

Except for the earlier tests with automatic flare-out landing for the C-54 aircraft, the flight test work on automatic landings has proceeded

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. . . Flare-Out Control

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concurrently with simulator studies conducted over the past year and a half. This has placed us in the favorable position of being able to verify our theoretical work by the acid test of actual flying, and at the same time has been very helpful to the project's progress.

As an example, an evaluation of a flare-out altimeter and computer was conducted in a C-54 aircraft equipped with a Sperry E-4 automatic pilot and automatic approach coupler. This system was essentially what we have termed the "basic flare-out system." It incorporated no other stabilizing devices, pitch reference, or airspeed control; the result was a totally inadequate and unsuccessful system. At the present time, work is being done to utilize the information we have presented here to develop a successful flare-out system employing the same equipment.

The personnel of the All-Weather Section have successfully flown two automatic flare-out systems.

The first of these systems was developed and evaluated in 1948 by the All Weather Flying Division at Clinton County Air Force Base, Wilmington, Ohio. This system utilized a C-54 aircraft, an AN/APN-1 radio altimeter, an E-4 automatic pilot and approach coupler, and a flare out computer designed and built by the All Weather personnel.

The basic idealized control equation of the flare-out equipment was:

$$A\ [h + K\dot{h} + B\int (h + Kh)\, dt] = \textit{error signal}$$

An attempt was made to use a second derivative term in the control equation, but this was abandoned because it promoted excessively fast control surface motions and apparently contributed little to the performance of the system. The derivative terms in the control equation were not mathematically perfect, since they were obtained by RC networks which, by their very nature, reduce the amplitude and phase lead of the output signal at the higher frequencies. As we have seen, this is actually a desirable feature.

The integral term was approximated by an electric motor which ran at a constant speed in a direction determined by the sign of the displacement from the desired path. This motor would command 1.5° pitch attitude per second in such a direction as to eliminate any errors. It was found through experience, however, that best performance was obtained if the motor was allowed to eliminate only errors below the path. This may be called another form of pitch reference signal.

No airspeed control was used during the actual flare, although airspeed was controlled automatically during the approach. At the beginning of the flare, the engines were adjusted to a pre-determined fixed power setting which enabled the aircraft to flare successfully.

The performance of the system was acceptable, the main difficulty being the drifting characteristics of the altimeter. The drift caused the asymptote to vary in absolute height in an unpredictable fashion.

In addition to the altimeter drift, the system was not entirely satisfactory because of the lack of an automatic airspeed control during the flare. The success of the landing was consequently largely dependent on the correctness of the fixed power setting; the touchdown airspeed might vary considerably as a result of gusts or other disturbances.

To its credit, the system incorporated a sufficient amount of smoothing in the flare-out computer to allow adequate tightness of control; moreover, the approximate pitch reference signal, from the integrating motor, eliminated steady displacement errors. The integrating motor, however, was not quite as positive in action as the pitch reference signal we have discussed previously, since it required the existence of an error to begin operating.

The work on automatic flare-out landing for the T-33 aircraft is being done under Project No. R-203-17.

At the present time, the system consists of an AN/APN-22 (XN-2) radio altimeter, a flare-out computer designed and built by Mr. Joseph Farris of the All-Weather Section, a Lear F-5 automatic pilot and approach coupler, and a Sperry miniaturized automatic airspeed control.

The flare-out computer assumes vertical control of the aircraft at about 100 feet altitude if a cross-pointer error from the desired rate of descent does not exceed two dots. This is a safety feature to preclude sharp transients at the transition for ILS operation to flare-out operation. The flare-out computer will engage itself at any height below 100 feet as soon as the error signal becomes less than two dots. The pilot is provided with an absolute height indicator and is thus aware if the flare-out computer does not engage.

During this linear descent, the flare-out computer differentiates the height information from the altimeter with the use of an RC network, compares the derivative with a fixed voltage (which represents the desired rate of descent), and transmits any discrepancies to the approach coupler.

After the exponential portion of the path is centered, the commanded rate of descent becomes proportional to height. The present All Weather flare-out computer thus approximates an ideal first order computer with a smoothing time constant, except for one important difference—in the All Weather computer, an error below the desired path causes an error voltage about four times as great as an error above the path. The computer's exact operation is therefore highly non-linear.

In addition to the path error signal, the flare-out computer also supplies an adjustable pitch reference voltage directly to the automatic pilot to eliminate displacement errors on the asymptote. This voltage is zero at the beginning of the exponential and increases linearly as height decreases.

Up to the present time, the commanded airspeed has been either kept at the same value during the flare or has been changed manually. Provision is now being made to do this automatically.

Approximately 100 successful automatic landings have been made with this system within the past eight months. During these landings, the pilot suddenly shifted the asymptote up or down as indicated on the records. This was done to check the tightness of control and the speed with which large transients would be damped out.

The system has been successful in flight tests up to the present time. Improvements in the circuitry of the flare-out computer are being made, and equipment is being added to remove any existing crab angle, at an appropriate height, which should permit smooth crosswind landings.

Flight tests of the system using a pitch rate signal added to the derived rate of descent in the flare-out computer are also planned to verify the findings of our simulator study.

LIST OF SYMBOLS

- h height, in feet, above flared path asymptote.
- $\dot{h}$ rate of descent, feet per second.
- K time constant of exponential path.
- θ pitch attitude of aircraft.
- U true airspeed in feet per second.
- W weight of aircraft, pounds.
- C_{La} slope of lift coefficient vs. angle of attack curve.
- ρ density of ambient air, slugs per cubic foot.
- S total wing area, square feet.
- p differential operator, $\frac{d}{dt}$.

. . . Power Output

(Continued from Page 19)

pressures so as to produce an increase in power, *i.e.*, "water-injection." Our concern is with water in the air in its gaseous state, *i.e.*, evaporated water or water vapor.

The quantity of water vapor that can be absorbed into the atmosphere varies with temperature, increasing as the air temperature rises. The quantity that is present at any given time may be expressed in any of four ways: "specific humidity," "relative humidity", "dew point", or "vapor pressure". Specific humidity is the weight of water in a given volume of air, *i.e.*, pounds per cubic foot. Relative humidity is the weight of water present in the air compared to the maximum amount that the air could absorb at the ambient temperature. Dew point is the temperature at which the air would be completely saturated by the amount of water vapor prevailing in the atmosphere. Vapor pressure is that portion of the atmospheric pressure that is due to the presence of the water vapor in the air and is usually expressed in terms of in. Hg. Specific humidity and vapor pressure generally are used in engineering computations, but relative humidity and dew point are the terms most widely used to convey humidity information. In recognition of the deleterious effect of humidity upon the power of an engine, the Civil Aeronautics Board (in 1951) introduced "humidity accountability" by requiring that the engine installations of transport aircraft type-certificated after that date be "de-rated" by the correction factor corresponding to 80% relative humidity at the standard temperature of each altitude.

The most important effect of humidity upon engine power arises through the displacement of dry air, and oxygen, by incombustible water vapor. Power decreases of secondary importance are produced by the resulting enrichment of the fuel-and-dry-air mixture or, more specifically, the "fuel-oxygen" ratio, and also by the influence of water vapor upon combustion efficiency of the engine. The first and last of the above items are generally applicable to all engines. The magnitude of the enrichment effect, however, depends upon the characteristics of the engine type and, therefore, cannot readily be generalized.

Considering the effects of oxygen displacement and combustion efficiency together, the humidity factor (in percent) can be approximated by

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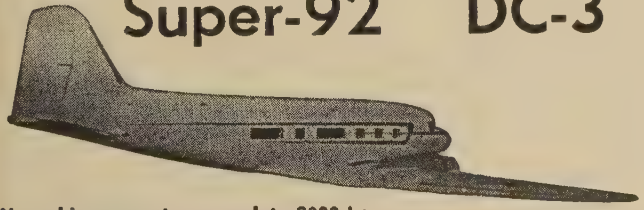

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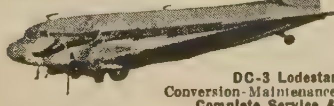

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(Continued from Page 37)

cost of depreciation. Apparently, a number of operators already have depreciated their aircraft or are close to it, so that under the depreciation column there is very little expense.

"Conceivably, the advantages accrued from the operation of presenday transports could offset the higher cost. Pressurization, for example, enables you to overcome the weather by flying above it and it reduces the problem of fatigue, passenger-wise. The extra speed of these transports is another advantage, and so is the ability to standardize a fleet. In fact, making use of current transports would mean that a fleet could consist of one or two types of aircraft rather than the conglomeration that now exists.

"Perhaps the best salesman for the Convair or Martin aircraft would be the fact that a competitor, using these newer type aircraft, is covering more territory in the same length of time and arriving at his destination in a more refreshed state, thanks to pressurization. Also, the pride of the boss himself may play an important part in the decision.

"Thank you, gentlemen, for your participation in this discussion. It will offer many business pilots the ammunition to suggest the change to newer air transports."

. . . Power Output

(Continued from Page 43)

squaring the dew-point temperature (in degrees Fahrenheit) and dividing by one thousand. This rule-of-thumb holds good up to a dew-point temperature of 80°F., above which a further correction must be added equal to 3% for each 10° above 80°F. Thus, for a dew-point temperature of 40°F. the approximate humidity factor is $[(40)^2/1000]$ or 1.6%. For a dew-point temperature of 90°F., an extreme case, the factor would be computed as $[(90)^2/1000 + \frac{3}{10}(90-80)] = 8.1 + 3.0$ or 11.1%.

As noted earlier, the above rule does not include the enrichment effect, the source of which may be attributed to the custom of utilizing extra-rich fuel-air mixtures for high-power operations to aid in engine cooling. The normal mixture supplied to the engine for take-off is richer than the "best power" mixture and a drop-off in power results from further enrichment produced by displacing dry air with water vapor.

Since the magnitude of the effect is dependent upon the engine characteristics, the carburetor characteristics, and humidity, it is difficult to form a general rule except to say that the enrichment effect normally is secondary to the other two. Furthermore, the mixture effect may be disregarded entirely for engines operating with "water injection" in which the fuel-air mixture has been "deriched" to the "best-power" ratio.

Generally speaking, the humidity correction for a given dew-point temperature increases with altitude to a minor degree—approximately 1% in 4,000 feet. However, this factor is within the tolerance of our general rules and may well be neglected. To summarize, let us determine the actual power output of our R-1830 engine during a full-throttle take-off from an airport at 4,000 ft. elevation, just above the critical altitude, with an air temperature of 85°F (40°F. above standard) and a dew-point temperature of 70°F (corresponding to a relative humidity of 60%):

A. Temperature
  1. Density Effect: 1% per 10°F =4.0% or — 48 BHP
  2. Full Throttle Effect: .25 in. Hg. per 10°F = 1.0 in. Hg. or — 25 BHP

B. Humidity
  3. Displacement & Thermal Efficiency Effect: $(70)^2/1000 = 4.9\%$ or — 59 BHP
  4. Enrichment Effect (assume 50% of Item 3 above): — 30 BHP

Total Power Drop-off = 162 BHP

Approximate Net Power Output = 1200 − 162 = 1038 BHP

The above-noted temperature and humidity conditions cause a drop-off in engine power of 162 BHP. However, when operating under such conditions, the power required by the airplane increases and causes a change greater than 162 BHP in the "excess power"—and the magnitude of the excess power is what determines the airplane's acceleration and climb performance.

From the foregoing we can draw one inescapable conclusion—your airplane won't be very "hot" on a hot and humid day.

Executive 'Copters

(Continued from Page 12)

requirements, produces a set of cost figures somewhat different from the standards compiled by Bell.

Any company which is considering the use of helicopters for executive transportation must decide whether the tremendous versatility it offers can be integrated economically into its operations. The answer will depend in each case on the number of persons in the organization who could make good use of such transportation, ground travel problems in the area and the special problems 'copters can help to solve.

I had an opportunity to acquire some flying time in autogyros many years ago and have since been invited to try my hand on various types of helicopters. My experience and my observation of the tremendous value of the helicopter as a valuable business tool convince me that they are here to stay—and in large quantities. I agree with those who believe that the helicopter will be the most frequently used business aircraft of the future for short-haul operations.

The operating cost of helicopters is a complex and variable subject which is influenced by the operator and the equipment.

In any study of operational costs, there are two categories under which all charges per flight can be placed—direct and indirect. In addition, there are certain overhead cost items that are strictly controlled by the operator. These include telephone, office space, supplies and scheduling. For the Bell 47G used by the Port Author-

(Continued on Page 48)

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DO YOU HAVE ALL THE ANSWERS?

turn to page 43

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Executive 'Copters

(Continued from Page 46)

ity, the best guide to accurate cost is the most recent set of figures compiled by Helicopter Air Service of Chicago. HAS best typifies tomorrow's normal helicopter operations with operating loads of more than 1,000 flight hours a year per 'copter.

According to W. C. Moore, HAS vice president, direct helicopter operation expense constitutes 60% of the total operating cost. Under the CAB's uniform system of accounts for air carriers, used by HAS, direct helicopter costs include fuel and oil, supplies, pilot salaries, insurance on flight equipment, maintenance, repairs and overhaul of property and flight equipment, and depreciation. Salaries, insurance, depreciation and items whose annual costs remain the same regardless of hours flown are fixed direct costs. Variable costs are those which increase with every additional hour of flight—fuel and oil, maintenance and spare parts.

Mr. Moore reports that flight operations (including insurance) account for roughly 38% of total helicopter flight expense, maintenance accounts for 44% and depreciation for approximately 18% with the Model 47. It is apparent that the greater the number of hours flown per year, the lower hourly costs will be. Sixty-five percent of cost reduction possibilities, he said, lies with the operator and his control over utilization, record of safety and its effect on insurance, period of depreciation selected, maintenance, and salaries.

Using CAB reports and its own records, HAS arrives at a total direct cost per flight hour of $37.71 as follows:

Flight Operations: Pilot salaries, $8.34; fuel and oil, $3.03; insurance, $2.21; total, $13.58. Maintenance: Labor, $8.69; airframe and rotor spares, $5.76; engines parts and labor, $2.13; total $16.58. Depreciation: Airframe, $2.20; engine, $1.03; all other (rotor), $4.32; total, $7.55. Grand Total: $37.71.

Mr. Moore believes that HAS is enjoying the lowest operating costs of all three scheduled helicopter air mail carriers in the U.S.—Ed.

Here is a typical day's operation in the life of one of the executive transport helicopters used by the Port of New York Authority:

8:45 a.m.	*Leave La Guardia hangar.*
8:55 a.m.	*Arrive Port Authority Bldg.*
9:00 a.m.	*Leave roof with PA personnel director, one other.*
9:10 a.m.	*Arrive Port Newark, leave immediately.*
9:20 a.m.	*Arrive PA roof.*
9:30 a.m.	*Leave PA roof with chief central main. div., one other.*
9:55 a.m.	*Arrive N.Y. Int'l Airport.*
10:00 a.m.	*Leave Int'l with staff member real estate dept.*
10:30 a.m.	*Arrive Newark Airport.*
10:40 a.m.	*Leave Newark Airport with assist. mgr. of airport.*
10:50 a.m.	*Arrive PA bldg. roof.*
10:55 a.m.	*Leave PA roof with director of marine terminals, one other.*
11:05 a.m.	*Arrive Port Newark, pilot's luncheon period.*
12 Noon	*Leave Port Newark with passengers left there at 9:10 a.m.*
12:10 p.m.	*Arrive PA bldg. roof.*
12:15 p.m.	*Leave PA roof on photo flight.*
12:55 p.m.	*Arrive PA roof, leave immediately with chief aviation development div., one other.*
1:10 p.m.	*Arrive La Guardia Airport.*
1:15 p.m.	*Leave La Guardia with gen. mgr. of airports.*
1:25 p.m.	*Arrive N.Y. Int'l Airport.*
1:30 p.m.	*Leave N.Y. Int'l. with passengers left there at 9:30 a.m.*
1:40 p.m.	*Arrive La Guardia, leave immediately no passengers.*
1:50 p.m.	*Arrive N.Y. Int'l., leave immediately with passengers left there by other 'copter at 10:25 a.m.*
2:15 p.m.	*Arrive PA roof, leave with one of two passengers still aboard.*
2:25 p.m.	*Arrive Teterboro Airport, leave immediately no passengers.*
2:35 p.m.	*Arrive Newark Airport, leave with passengers left there by other 'copters at 12:10 p.m.*
2:45 p.m.	*Arrive PA roof.*
2:50 p.m.	*Leave PA roof on photo flight.*
3:50 p.m.	*Arrive PA roof.*
3:55 p.m.	*Leave PA roof with two passengers on harbor inspection tour.*
4:25 p.m.	*Arrive PA roof.*
4:30 p.m.	*Leave PA roof, no passengers.*
4:40 p.m.	*Arrive La Guardia hangar.*


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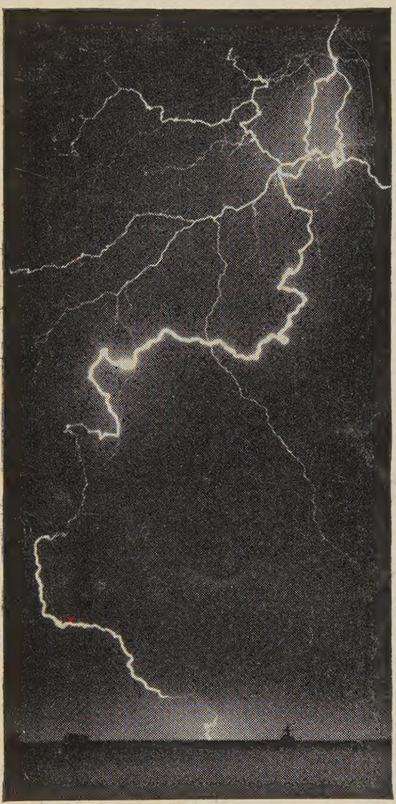
FLY WEATHER-WISE

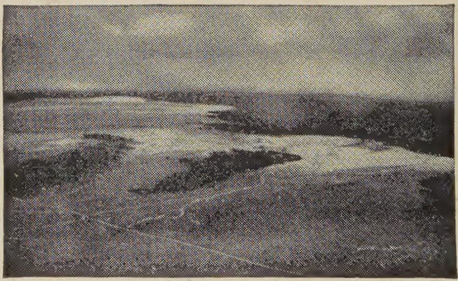
These weather items prepared in consultation with the United States Weather Bureau

Scattered clouds common to fair weather indicate an unstable layer of air. For smoother flying avoid this bumpy area by flying above the cloud tops or below the level of the cloud bases.

UNITED AIR LINES PHOTO



Unlike squall line thunderstorms, the common "nocturnal" thunderstorm which forms in late evening over Mid-western U.S.A. has a high base, and smooth flight is often possible in the clear at about 4,000 feet.



Be prepared for hail in early stages of after-noon thunderstorms at about the time of first lightning. Hail falls in narrow shafts often outside the parent cloud (CB). Note hail pattern on ground in above picture.

Flying down valleys avoid leeward sides when winds are blowing strong across the ridges. The down-slope currents are often more turbulent—harder to keep altitude—than the up-slope currents on the windward side.

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